TECHNICAL MANUAL

MAINTENANCE INSTRUCTIONS

POWER PLANT
USAF SERIES F-4C AIRCRAFT

McDonnell Aircraft

NOw(A)63-0032-i

F42600-78-D-0021

This manual supersedes T.O. 1F-4C-2-8S-42, -8S-43, -8S-44, -8S-45 and -8S-46.

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LIST OF TABLES

SECTION I

INTRODUCTION

1-1. DESCRIPTION AND USE.

1-2. This technical manual is one of a series providing information and maintenance instructions for the F-4C series aircraft manufactured by McDonnell Aircraft Company. **For a list of maintenance instructions** manuals and information on the use of data presented in the manuals, refer to T O 1F-4C-2-36.

1-3. Section II of this publication contains all the checkouts and troubleshooting information for engine related systems. Refer to sections III thru XI for system description and component replacement. Section XII deals with basic engine description and serviceable damage limits. Section XIII contains a pictorial engine change procedure plus engine associated access door information and replacement procedures for engine/airframe interface items. Section XIV is the Engine Bay Configuration Integrity Guide for use during Quality Control Inspections of the compartment while the engine is removed.

1-4. Information and instructions for maintenance performed on the aircraft as provided in this manual are compatible with the provisioning of spare parts, special tools and test equipment. Maintenance instructions for Government Furnished Aircraft Equipment (GFAE) are included only when peculiar to the installation in the aircraft or when not provided by separate maintenance manuals. Maintenance instructions for testing and/or repair of components when removed from the aircraft are included when compatible with provisioning and not provided by separate maintenance manuals.

1-5. REVISION.

1-6. The significant changes incorporated in this revision are as follows:

a. Improved system schematics.

b. Improved checkout procedures.

c. Improved troubleshooting procedures.

d. Reorganization of related systems.

e. Incorporation of T O 1F-4C-598 (Multi-Station ECM Wiring Provisions) into the Engine Bay Configuration Integrity Guide.

1-7. GENERAL MAINTENANCE INFORMATION.

1-8. For general information including access provisions, ground power connection procedures, and safety data, refer to T O 1F-4C-2-36.

1-8A. LOCKWIRING OF "V" BAND CLAMPS. Specific instructions are provided by this technical order for lockwiring of "V" band clamps. All "V" band clamps will use two self locking nuts on T—bolts and do not require lockwiring unless identified as requiring lockwire in the installation instructions of this technical order.

1-9. GROUND HANDLING AND SERVICING. For ground handling and servicing procedures, refer to T O 1F-4C-2-2.

1-10. MASTER TROUBLESHOOTING MANUAL.

1-11. The master troubleshooting manual contains lists of all the flight and ground operations symptoms, including those related to the systems in this manual, for which troubleshooting procedures have been prepared. These symptom lists contain references to troubleshooting procedures contained either in this manual or in the master troubleshooting manual. Troubleshooting procedures contained in the master troubleshooting manual are supported by troubleshooting schematics. Refer to T O 1F-4C-2-34.

1-12. TIME COMPLIANCE TECHNICAL DIRECTIVES.

1-13. All known technical directives applicable to this manual which have not been incorporated on all affected aircraft, are listed in table 1-1. Some technical directives may be listed prior to release date.

Table 1-1. Record of Applicable Time Compliance Technical Directives

Technical Directive (T.O.)	Directive Date	Title	Manual Change/Revision Supplement Date
1F-4-716 1F-4-716C 1F-4-716D	10 Apr 69 30 Apr 69 15 Jan 71	Installation of Engine Oil Sample Drain Line, P/N 57007-134, J79-15 and J79-17 Engine F-4 series. Aircraft and Trainers, F-4 MTS 1 thru -101, TFE-11 and TFE-111 Jet Engine System, AT-1 Jet Engine System (ECP MDA-F-4-8081).	1 May 69 1 Dec 69 1 Nov 71
1F-4-755 1F-4-755C	1 Aug 70 15 Apr 71	Installation of Class V Mod 1747 (Seek Silence) in F/RF -4C/D Aircraft (ECP MDA-F4-703S3)	1 Aug 70 1 Nov 71
1F-4-776	1 Mar 70	Incorporation of Additional Formation Lights, F/RF-4C/D/E Aircraft and Trainers TFE-5, TFE-105, TFE-205, TFE-20, TFE-120, CT-43 AND ST-49 (ECP MDA-F4-852)	1 Oct 78

CONTINUED

Table 1-1. Record of Applicable Time Compliance Technical Directives (CONT)

Technical Directive (T.O.)	Directive Date	Title	Manual Change/Revision Supplement Date
1F-4-849 1F-4-849F	1 Jul 69 20 Jan 71	Installation of Self-Retaining Bolts in Critical Control System and Components, F/RF-4C, D(IR), D, E(IS) and E Aircraft and Trainers.	1 Oct 69 15 Dec 70
1F-4-860 1F-4-860C 1F-4-860E 1F-4-860F 1F-4-860G	30 Jan 70 30 Apr 70 1 Jul 70 27 Jul 70 5 Apr 71	Installation of Power Quadrant Finger Lift Idle Stop on F-4C/D/E and RF-4C Aircraft Trainers. (ECP MDA -F/RF-4-900R1)	1 Dec 69 1 Aug 70 1 Nov 71 1 Nov 71 1 Nov 71
1F-4-889 1F-4-889C 1F-4-889E 1F-4-889H 1F-4-889J	15 Jan 70 10 Apr 70 7 Apr 70 15 Jul 70 30 Oct 70	Rerouting of Engine Bay Wiring Bundles, Rerouting and Reclamping of QEC Wiring, Hoses and Tubing, F -4C/D/E and RF-4C Aircraft. (ECP MDA-F-4-980 and 980S1)	29 Dec 69 29 Dec 69 1 May 70 15 Mar 71 15 Mar 71
1F-4-942	7 May 71	Installation of Cover, P/N BW501 On Throttle Quadrant Micro Switches, F/RF-4C Aircraft	15 Mar 72
1F-4-946	15 Jul 71	Incorporation of a Distinctive Identifying Feature on Engine Master Switches - F-4C/D/E and RF-4C Aircraft	15 Mar 72
1F-4C-598 1F-4C-598C	20 Mar 70 20 May 71	Multi Station ECM Wiring Provisions, Inboard Wing Pylon, F-4C Aircraft	15 Mar 72 15 Mar 72
2J—J79—1208	15 Jun 72	Modification of Air Pressurizing and Vacuum Relief Valve on J79—GE—15/—15A and —17/—17A Engines.	1 Jun 73
2J—J79—1217	30 Mar 72	Replacement of Throttle Control Box 868C872P2 with 517D935P1 and Rework of Bracket 867C840P1 to 867C840P on the J79—GE—15/—15A, J79—GE—17/—17A Engines.	1 Jun 73
1F—4—991		Structural Fatigue Improvements — F—4 Aircraft. (ECP MDA—F4—1014R1S3, S10, S12)	15 May 75

SECTION II

GROUND OPERATION, CHECKOUT AND TROUBLESHOOTING

2-1. GENERAL.

2-2. The following information is included to assist maintenance personnel with the equipment and procedures used in starting and troubleshooting the J79 turbojet engine installed in F-4 aircraft.

2-3. **SINGLE ENGINE OPERATION.** Single engine operation with one engine removed is permissible. The fuel lines and air bleed lines must be capped, drop out link and engine bay doors must be installed in the removed engine compartment.

2-4. **OPERATIONAL PRECAUTIONS.** Structural limitations require certain access panels to be installed on aircraft during ground handling, maintenance, or servicing. Because structural access panels are highly stressed panels, care should be observed when handling and storing them. Scratches, nicks, and bends must be prevented as they tend to cause fatigue failure.

2-5. **Foreign Object Damage (FOD) Precautions.** When maintenance of the aircraft takes place in the area of the engine inlet ducts or the engine nacelles, vacuum clean surrounding structural area. Cleaning the engine inlet and nacelle area cannot be over emphasized in order to protect the engine from entry of foreign materials which cause serious damage to engine. General precautions listed should be adhered to at all times. See figure 2-1.

2-6. **TOOLS AND TEST EQUIPMENT.** To perform maintenance on the system or components, the tools and test equipment listed in table 2-1 should be used. Alternate equipment with equal or greater range and accuracy than that in the Alternate Equipment column may be substituted.

2-7. **CIRCUIT BREAKERS.** All circuit breakers associated with the Power Plant are located and identified in figure 2-2.

Table 2-1. Tools and Test Equipment

Name	Identification No.	Alternate Equip. Range	Alternate Equip. Accuracy	Use
Power source, external electrical and pneumatic	M32A-60	200/115V, 400 Hz, 3Ø 120 lb/min @ 49 psia, U.S. Standard Atmosphere at sea level		Engine starting
Jetcal analyzer	BH112J or BH112JA			System checks and adjustment
Jetcal analyzer/trimmer	BH112JB-40			System checks and adjustment
Accessories, BH112JB-40 Jetcal analyzer/trimmer	See fig 2-27A			
Flight line tester	1C2994G2			Remote readout of nozzle and variable vane position, throttle angle and engine RPM during engine operation.
Pressure readout gage set	1C2995G2			Read engine pressures
Overtemperature control system tester	1C2863G8			Check temperature amplifier circuit
Tester, lube oil system	1C3903G1			Remote oil temperature readout
Oil servicing unit	PMU-29/E			Service lubrication system
Check kit, gear box wear, throttle control	MDE323790-1			Throttle system wear checks

CONTINUED

Table 2-1. Tools and Test Equipment

Name	Identification No.	Alternate Equip. Range	Alternate Equip. Accuracy	Use
Strut assy, aux air door	32E050034-1			Hold auxiliary air door open
Scale, spring		0 to 10 inch pounds		Idle throttle check
Adapter	1C2754—3G1 (part of 1C3946G2)			Throttle wear checks
Rig pin	1C2754—13G2 (part of 1C3946G2)			Throttle Rigging
Air duct guards	MDE32786—301L MDE32786—302R			Cover inlet ducts during engine engine operation
IGV transmitter attaching rod	Local Manufacture see fig 2-18			Attach IGV transmitter to QEC engines
Holdback assembly	53E030001			Engine run—up holdback
Gearbox backlash tool	Local Manufacture see fig 2-28			Check gearbox backlash
Ground, equipment communication	H—133C/AIC			Engine operator to ground observer
Fuel pressure source, torque booster	53E390214-1			Pressurize torque booster
Pressurizing unit, variable vane (JP-4 or JP-5 fuel)	1C3568G1			Functional testing of variable vanes

2-8. GROUND OPERATION.

2-9. PREPARATION.

2-10. Tools and Equipment.

Adapter, 1C2754-3G1
Scale, spring, 0 to 10 pounds
Wrench, torque, 0 to 50 inch-pounds
Communication equipment, ground
Safety struts, auxiliary air door
Guards, air duct
Tester, lube oil system
Holdback assembly (if required)
Power source, external electrical
Power source, external pneumatic

2-11. Manpower Requirement.

a. Three men required.

2-12. Procedure.

a. Position aircraft at runup site.

(1) Head aircraft into wind if possible. Engines may be run crosswind, if necessary, because of tie downs or blast fences. However, downwind runs should be avoided.

(2) If a muffler is used, assure exhaust nozzle is aligned, fits well and is not restricted in its movement per applicable directive.

b. Install engine runup holdback assembly, if required. Use of holdback assembly is mandatory for engine operation at power settings above MIL power. See figure 2-3.

(1) Position aircraft about four feet from anchor and in direct line with it.

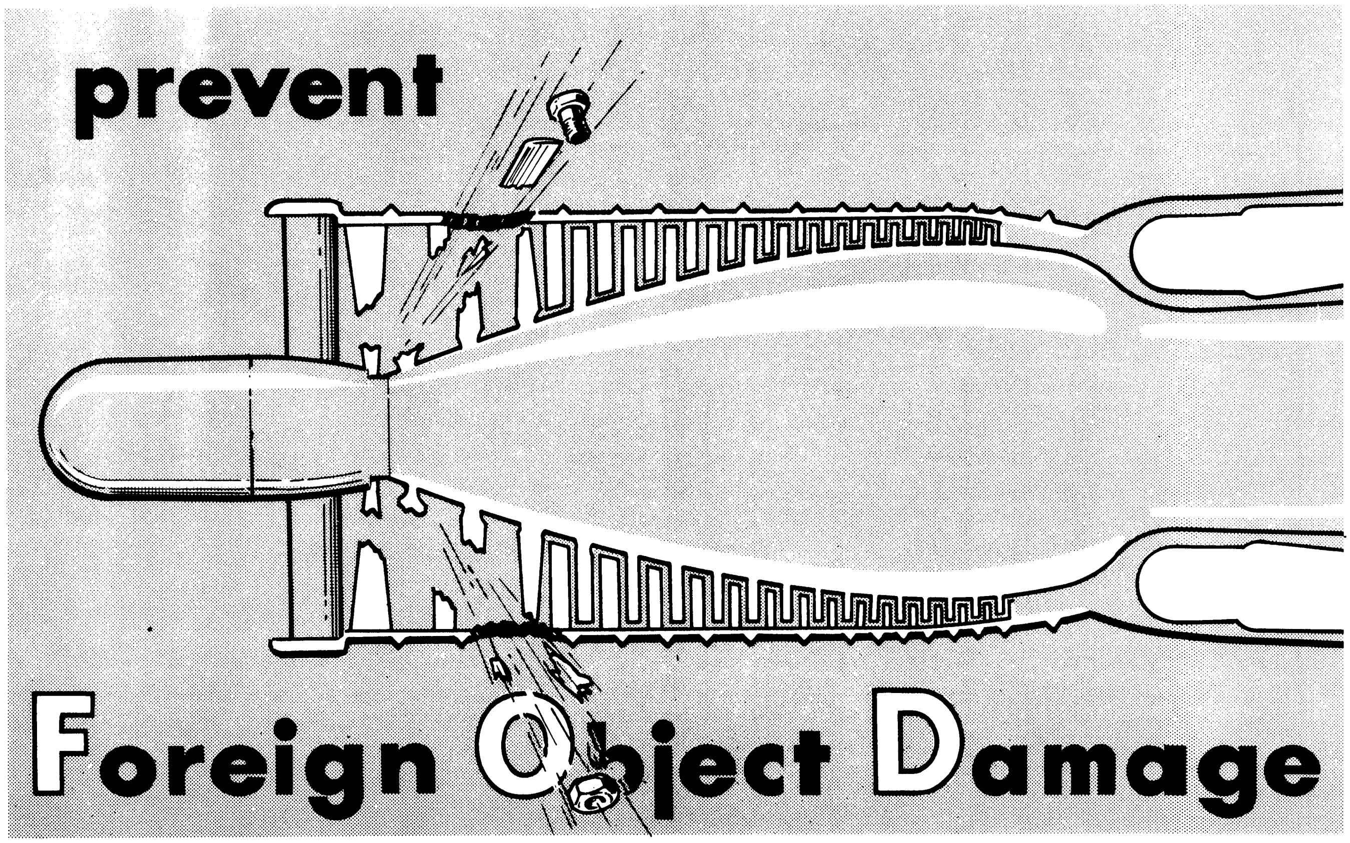
(2) Lower arresting gear by actuating mechanical release mechanism in forward cockpit.

(3) Disconnect quick release anchor fitting from holdback.

(4) Remove bolt from anchor fitting and attach to adapter link of aircraft anchor.

(5) Remove quick release pin in frame of holdback and swing out retaining bar.

(6) Slide yoke forward at angle of 30° to ground until U bolt contacts end of hook below uplatch retaining hook.



INSTRUCTION

- MAINTENANCE PERSONNEL IN FLIGHT LINE AREA TO BE THOROUGHLY BRIEFED ON IMPORTANCE OF MAINTAINING AS CLEAN AN AREA AS POSSIBLE.
- INDIVIDUALS TO CONSCIENTIOUSLY PRACTICE PICKING UP ANY OBSERVED FOREIGN OBJECT AT ANY TIME.
- AIRCRAFT OPERATING PERSONNEL TO AVOID RUN-UPS OR TAXIING INTO EXHAUST BLASTS OF OTHER AIRCRAFT.
- AIRCRAFT OPERATING PERSONNEL REPORT IMMEDIATELY UNSATISFACTORY CONDITIONS OF OPERATING SURFACES WHEN ENCOUNTERED.

INSPECTION

- INSPECT OPERATING SURFACES DAILY FOR CHIPPING AND DETERIORATION.
- INSPECT AREAS NORMALLY CROSSED OR ENTERED INTO BY TRANSIT VEHICLES FOR MATERIAL CARRIED BY TRUCK TIRES, ETC.
- AFTER EACH MAINTENANCE OPERATION INVENTORY ALL TOOLS AND PARTS.
- INSPECT THE INLET DUCT AREA FOR ALL FOREIGN OBJECTS.

PREVENTION

- PERIODIC GENERAL PHYSICAL PICKUP BY MAINTENANCE PERSONNEL ("POLICE-THE-AREA").
- AVAILABILITY OF STRATEGICALLY LOCATED AND APPROPRIATELY MARKED FOREIGN OBJECT DAMAGE RECEPTACLES.
- PROTECTIVE SCREENS USED WHEN APPROPRIATE.
- ARTICLES OF CLOTHING AND PERSONAL EFFECTS PROPERLY FITTED, AND SECURE.

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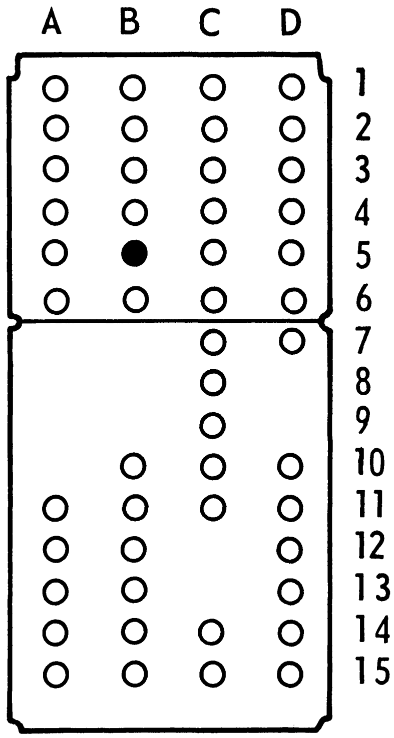
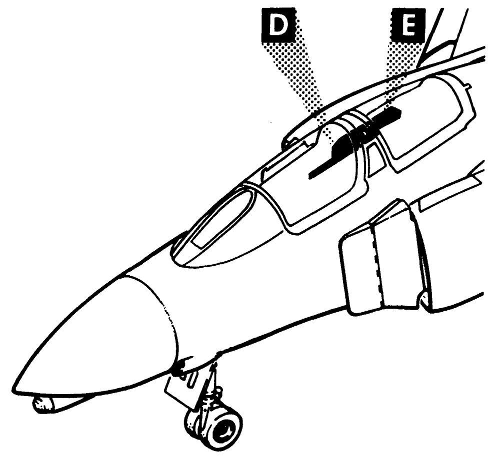
Figure 2-1. FOD Prevention





NOTES

1 ON 62-12199 THRU 63-7597
2 ON 63-7598 THRU 64-928
3 ON 63-7598 THRU 64-672
4 ON 64-673 THRU 64-928

E	NO. 3 CIRCUIT BREAKER PANEL			
REF DES	NOMENCLATURE		AMP	ZONE
	FUNCTION	BUS		
39CB301	ANTI-ICE	LH 115VAC ØC	5	5B

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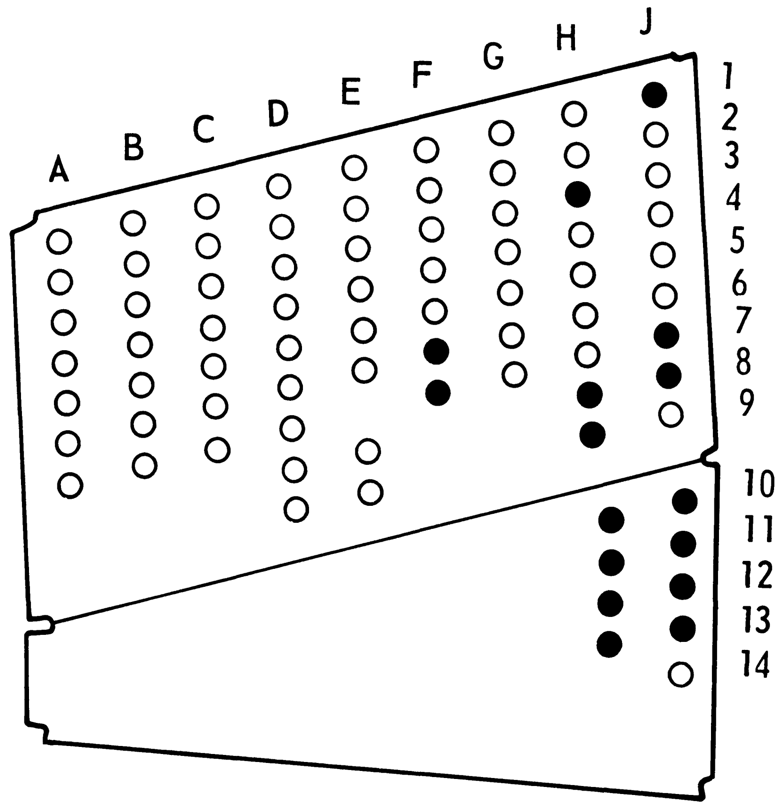
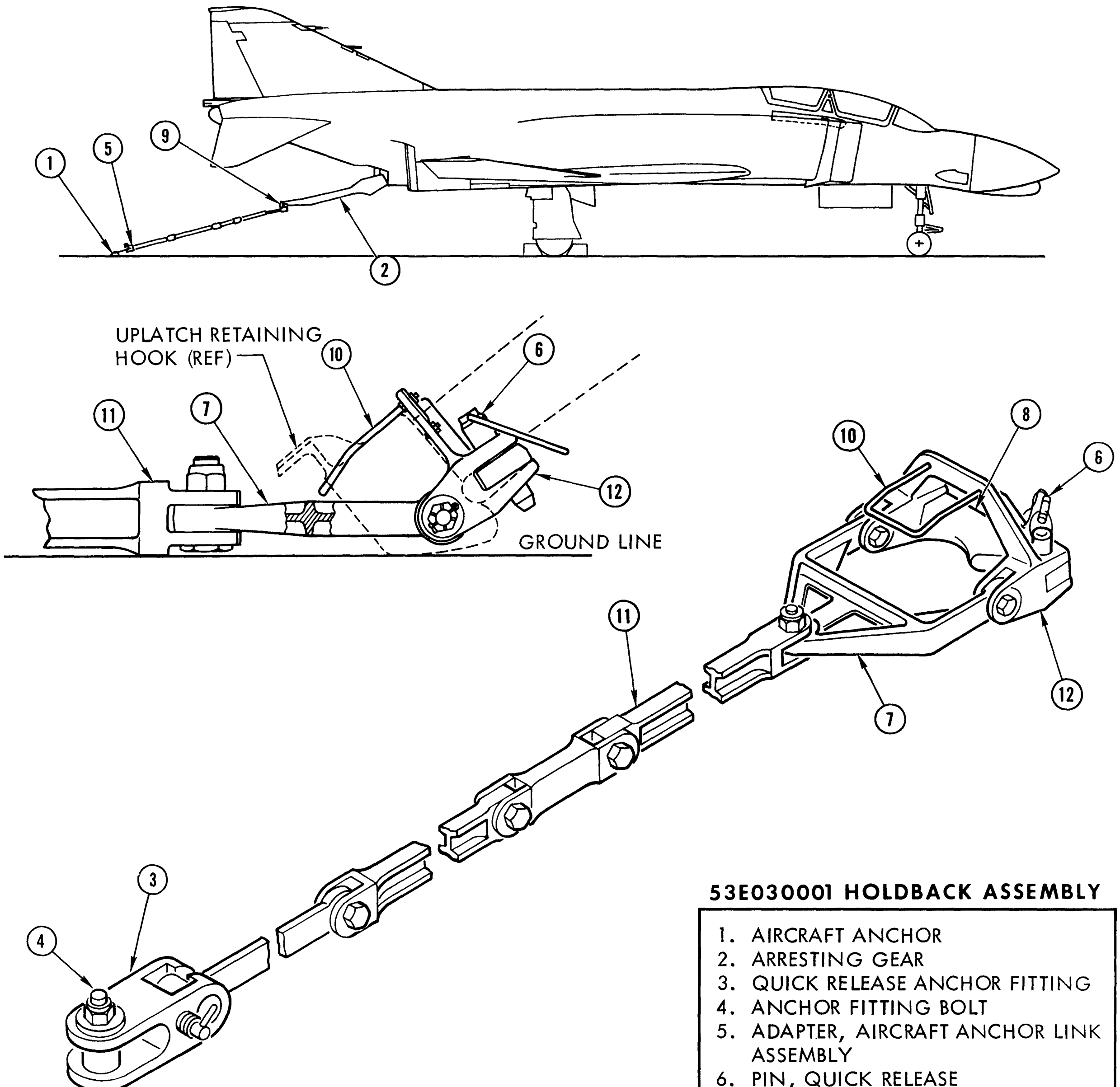
Figure 2–2. Engine Control Circuit Breakers (Sheet 1 of 2)



D — NO. 2 CIRCUIT BREAKER PANEL				
REF DES	NOMENCLATURE — FUNCTION	NOMENCLATURE — BUS	AMP	ZONE
5CB304	R MAIN IGNITION	ESS 28V DC	10	13J
5CB305	L AFTERBURNER IGNITION	LH 115V AC ØA	5	10J
5CB306	R AFTERBURNER IGNITION	LH 115V AC ØA	5	11J
5CB307	L MAIN IGNITION	ESS 28V DC	10	12J
[1] 5CB311	L IGN UNIT #1	ESS 28V DC	5	10H
[2] 5CB311	L IGN UNIT #1	L IGN 28 DC	5	10H
[1] 5CB312	R IGN UNIT #1	ESS 28V DC	5	12H
[2] 5CB312	R IGN UNIT #1	R IGN 28V DC	5	12H
[1] 5CB313	L IGN UNIT #2	ESS 28V DC	5	11H
[2] 5CB313	L IGN UNIT #2	L IGN 28V DC	5	11H
[1] 5CB314	R IGN UNIT #2	ESS 28V DC	5	13H
[2] 5CB314	R IGN UNIT #2	R IGN 28V DC	5	13H
6CB301	ENG OIL PRESS IND	INSTR 28V AC	5	8J
[3] 7CB333	RH MAIN FUEL CONTROL	ESS 28V DC	5	1J
[4] 7CB333	MAIN FUEL CONTROL	ESS 28V DC	5	1J
[3] 7CB356	LH MAIN FUEL CONT	ESS 28V DC	5	3H
[4] 7CB356	LH MAIN FUEL CONTROL	ESS 28V DC	5	3H
[1] 12CB301	ENG FUEL FLOW METERS	INSTR 28V AC	5	7J
[2] 12CB301	FUEL FLOW METERS	INSTR 28V AC	5	7J
75CB301	NOZZLE POS IND	ESS 28V DC	5	8H
[1] 81CB303	T.O.T. INVERTER	ESS 28V DC	5	9H
[1] 81CB308	RH EGT	ESS 28V AC ØB	5	6F
[1] 81CB309	LH EGT	ESS 115V AC ØB	5	7F
[2] 81CB303	EGT INVERTER	ESS 28V DC	5	9H

4C-2-8-(168-2)

Figure 2-2. Engine Control Circuit Breakers (Sheet 2 of 2)



53E030001 HOLDBACK ASSEMBLY

1. AIRCRAFT ANCHOR
2. ARRESTING GEAR
3. QUICK RELEASE ANCHOR FITTING
4. ANCHOR FITTING BOLT
5. ADAPTER, AIRCRAFT ANCHOR LINK ASSEMBLY
6. PIN, QUICK RELEASE
7. YOKE
8. BAR, RETAINING
9. HOOK, ARRESTING GEAR
10. U-BOLT
11. HOLD BACK ASSEMBLY
12. FRAME

NOTE

THERE ARE NO ENGINE OPERATING LIMITATIONS IN SO FAR AS THE RUN UP HOLDBACK ASSEMBLY IS CONCERNED. ENGINE OPERATING LIMITS THEREFORE WILL BE DETERMINED BY LOCAL REGULATIONS ON USE OF POWER CHECK PAD. IT IS RECOMMENDED THAT ONLY ONE ENGINE AT A TIME BE OPERATED IN AFTERBURNER AS A STANDARD PRACTICE.

A/C LOAD	36,450 POUNDS
PAD	60,000 POUNDS
HOLDBACK ASSEMBLY	114,000 POUNDS

4C-2-8-(109)

Figure 2-3. Run-Up Holdback Assembly

(7) Swing retaining bar into place and replace quick release pin.

(8) Attach holdback assembly to anchor pin fitting.

CAUTION

Do not remove all the slack from the holdback assembly with tow equipment. This can result in overstress on the nose gear strut and strut failure.

c. Position equipment per TO 1F-4C-2-36, and ensure equipment is free of FOD.

d. Inspect and police runup area for foreign objects.

e. If trim run is to be performed, place thermometer as near to trim pad as possible to obtain temperature for charts utilizing CIT.

CAUTION

If engine run is to be performed with actuators disconnected from auxiliary air doors, ensure doors are securely fastened in the open position to prevent flapping. This will prevent structural damage to auxiliary air doors.

f. Ensure safety devices are installed.

g. Remove protective covers.

h. Perform the following FOD inspection.

CAUTION

Cleanliness of inlet air ducts and ramp areas cannot be overemphasized in order to protect engine from entry of foreign materials and serious damage.

(1) Using strong light, inspect engine inlet duct and compressor.

CAUTION

If compressor turns easier than normal without clicking sound, possible inlet gearbox failure could exist. Do not start engine until corrected.

(2) During compressor inspection, manually rotate the compressor clockwise. Check for excessive free movement and a clicking sound from the starter ratchet assembly.

(3) Inspect inlet air duct guards for foreign objects and serviceability.

(4) Install inlet air duct guards.

(5) Using strong light, inspect exhaust section for serviceability, fuel accumulation and FOD.

i. Deactivate air compressor by opening door 23.

2-13. PRE-RUN PRECAUTIONS.

NOTE

During engine ground operation utilize T O 1F-4C-2-8CL-1.

a. All ground operations are to be monitored by qualified personnel. Supervisor is to be stationed outside of aircraft, in full view of engine operator. Supervisor to maintain intercom contact with operator.

NOTE

Refer to T O 1F-4C-2-10 for fuel transfer instructions. Automatic fuel transfer can be stopped at any time by extending air refueling receptacle.

b. Engine operation must be suspended any time fuel starts to spill from vent mast.

2-14. Restrictions Using JP-5 Fuel Without Resetting Specific Gravity Adjustments.

a. Ambient temperature is above −20°F.

b. Rates of throttle movement:

(1) IDLE to MIL - 6 seconds minimum.

(2) 85 percent to MIL - 3 seconds minimum.

(3) Stabilize at MIL then advance to MIN AB.

(4) MIN AB to MAX AB - 3 seconds.

2-15. Airframe Engine Runup Limitations. Observe following ground operation precautions during engine runs on installed engines.

a. Hold flight control stick in neutral position during ground run and taxiing to prevent overheating of stabilator control surface by engine exhaust.

b. While performing maintenance or leak checks, it is mandatory to have doors 92 L and R and 96 L and R closed during operation above 85 percent RPM to prevent engine compartment overheating. Observe 30 second limit for runs at MIL and above when these are only doors closed.

c. There are no limitations on engine runs in regard to structural overheat, if all engine access doors are closed and auxiliary air doors are open.

CAUTION

Do not attempt to start engines with flaps down.

Do not time engine accelerations during throttle bursts with flaps down when boundary layer bleed air is being used on aircraft.

Do not operate engines at MIL for more than 1 minute with flaps down.

d. During single engine operation, do not move control stick as cavitation of dual system actuators

will occur. The inactive power control system reservoir will indicate overfull. Do not drain excess fluid, for when this power control system is activated, fluid level will return to normal.

e. All personnel in vicinity of operating engine must wear an approved type ear plug, ear muff, or both.

2-16. PRE-START PRECAUTIONS.

2-17. GROUND CHECKS.

a. Check aircraft forms (AFTO 781).

b. Ensure fuel, oil, hydraulic nad pneumatic systems are properly serviced.

c. Check for fuel, oil, or hydraulic leaks.

d. Inspect throttle shaft and clevis link bolts for proper tightness and cotter pins installed.

e. When performing engine run for maintenance, drain door 92 L or R tank after engine has been shut down three times. Refer to section XIII.

2-18. COCKPIT CHECKS (POWER - OFF).

2-18A. Rear Cockpit Check.

a. Ensure seat and canopy safety devices are installed before entering cockpit.

b. Emergency flap handle - forward

c. Emergency gear handle - in and secure

d. Set all circuit breakers and fuses except bellmouth pitot heater, AOA probe heater, oxygen gage and engine ramp control. Ensure variable ramps are fully retracted before pulling circuit breakers.

e. Set all switches to normal, safe or off except those required for engine operation.

2-18B. Front Cockpit Check.

a. Ensure seat and canopy safety devices are installed before entering cockpit.

b. Check fuel control panel switches:

(1) Wing Station Jett Switch - NORM

(2) Center Station Jett Switch - NORM

(3) Internal Wing Transfer Switch - STOP TRAN

(4) Internal Wing Dump Switch - NORMAL

(5) Refuel Selection Switch - ALL TANKS

(6) External Transfer Switch - OFF

(7) Air Refuel Switch - RETRACT

(8) Boost Pump Fuel Switch - NORMAL

c. Engine master switches - OFF

d. Throttles - OFF

e. Speed brake switch - in.

f. Throttle friction - set as desired

g. Anti-skid switch - OFF

h. Drag chute handle - in and secure

i. Wing flaps - up

j. Emergency flap handle - forward

k. Antenna selection - upper

l. Anti-icing switch - normal

m. Emergency brake handle - in and secure

n. Landing and taxi light - OFF

o. Landing gear handle - DN and in

p. Canopy emergency jett handle - forward

q. Master arm switch - SAFE

r. Station select buttons - out

s. Generator switches - OFF

t. Pitot heat - OFF

u. Rain removal - OFF

v. FORMATION lights - OFF

2-19. COCKPIT CHECKS (POWER - ON).

a. Apply external electrical power to aircraft.

b. Front cockpit, generator switches - EXT ON.

c. Rear cockpit check.

(1) Inst ground switch - activate.

(2) Intercomm - set

(3) Ensure canopy pneumatic system is fully charged, if canopy is to be operated.

(4) Rear canopy strut - remove (if required)

d. Forward cockpit check.

(1) Set all circuit breakers and fuses.

(2) Front seat canopy strut - remove (if required)

(3) Landing gear indicators - gear down

(4) Flap indicators - up

(5) Warning and indicator lights - test

(6) Fire warning circuit - test

(7) Interior lights - as required.

(8) Exterior lights - ON

(9) FORMATION lights - OFF

NOTE

Fuel transfer into fuselage tanks may be commenced at 3000 pounds or less provided transfer is stopped when fuselage fuel reaches 6500 pounds.

(10) Fuel quantity indicator - check

(11) RAT control handle - RAT in

(12) Perform boost pump pressure check: Boost pump check switch - check, or engine master switch ON and throttle at IDLE. Pressure indication of 25 to 35 psi.

CAUTION

To prevent radio failures, limit CNI ground operation to 10 minutes when cooling air is not available.

(13) UHF radio - ON. Energize CNI ground power switch (left wheelwell).

(14) Intercom - establish contact with observer

NOTE

UHF transmission on lower antenna can cause fluctuation of EGT, RPM, FUEL FLOW and NOZZLE position indications during engine operation.

(15) Comm system - ON; Establish contact with tower or ground control.

2-19A. EMERGENCY ENGINE SHUTDOWN. See figure 2-3A.

a. Move throttle to OFF.

NOTE

Ensure friction lever is full aft.

b. If throttle cannot be moved to OFF, move ENGINE MASTER switch to OFF.

c. If engine cannot be shut down electrically, perform following:

(1) Ensure safety struts are installed on doors 81L and R actuators.

(2) Open doors 82L or R.

(3) Remove bolt from clevis arm and move fuel control shaft to cutoff by moving input arm aft to stop.

2-20. ENGINE OPERATION.

2-21. ENGINE STARTING (PNEUMATIC MODE).

a. Ensure cartridge is removed from each starter breech before making pneumatic start.

b. Perform pre-start precautions, refer to paragraph 2-16.

c. Connect external pneumatic power source as follows: See figure 2-4.

(1) Open starter exhaust doors 78 and 80 and pneumatic inlet doors 138 and 139.

(2) Remove pneumatic inlet duct cap.

(3) Remove kinks in starter air delivery hose by stretching hose out straight.

(4) Start power unit. Refer to OPERATING INSTRUCTION PANEL on power unit.

WARNING

To prevent injury to personnel, air delivery hose must be free of kinks and twists before performing hose blow out operation.

(5) When power unit reaches operating speed, place air outlet valve switch momentarily ON to blow out hose.

d. Connect compressed air delivery hose to pneumatic inlet duct.

e. Ensure fireguard is in position for engine start.

CAUTION

If engine is motored or dry cycled, ensure applicable throttle and master switch are in OFF position. This will prevent loading of engine with fuel which could cause hot start or fire during subsequent engine start.

f. Move LEFT or RIGHT ENGINE MASTER switch ON.

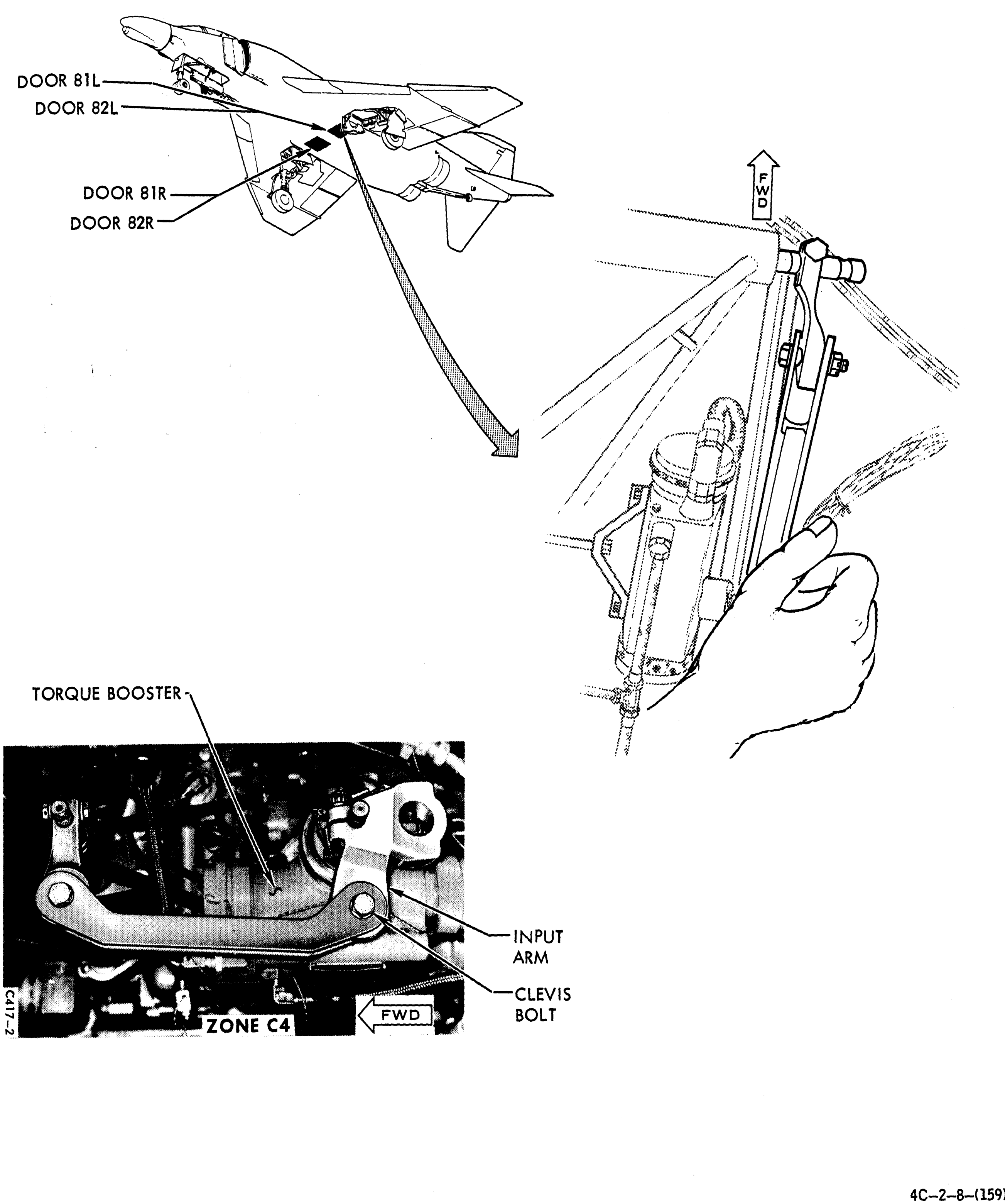
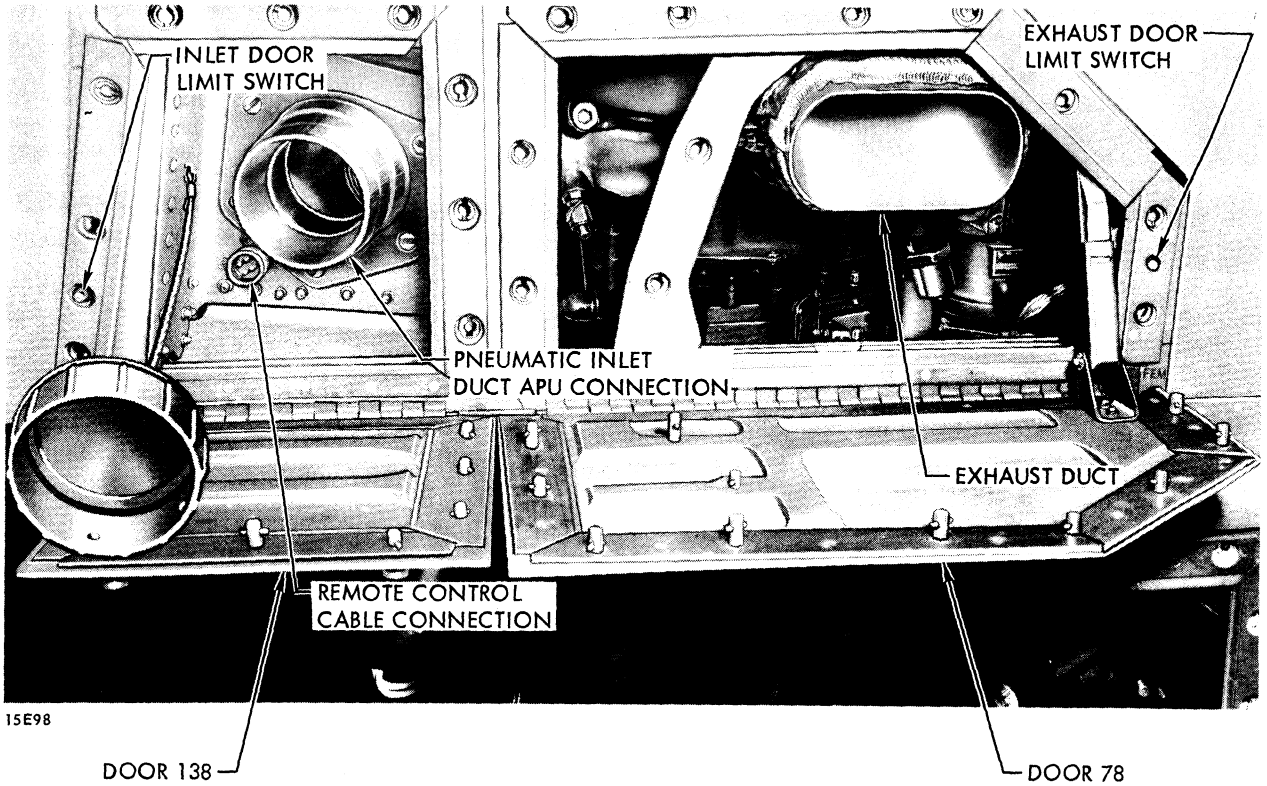
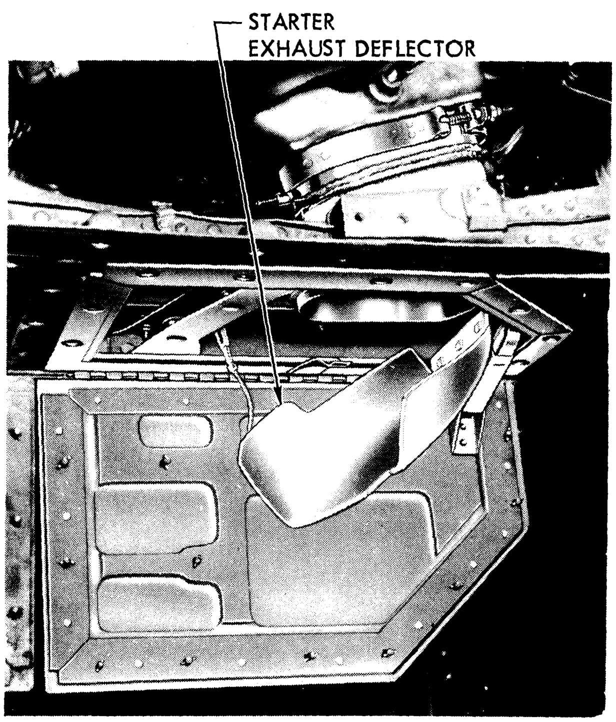
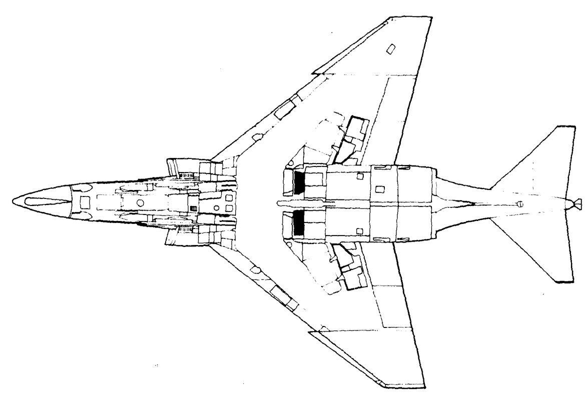


Figure 2-3A. Emergency Engine Shutdown





EXHAUST DEFLECTOR INSTALLED ON 62-12199 THRU 64-928 AFTER T.O. 1F-4-861.



4C-2-8-(110)

Figure 2-4. Pneumatic Starting Connections

CAUTION

To avoid starter damage, limit pneumatic starts to three within a 15 minute period. Do not motor starter continuously for more than 5 minutes.

To avoid starter damage, engine must come to complete stop before attempting another start.

Watch for and remove from service any power unit which exhibits erratic operation such as a surging gas turbine or fluctuating air pressure.

If RPM increases faster than normal, abort the start. Possible engine inlet gear box failure could have occurred. Positive confirmation of engine compressor rotation should be made prior to attempting another start.

g. Signal observer to move air outlet valve switch ON and check for the following indications. If not present shutdown and investigate.

(1) RPM indication within 15 seconds.

(2) Oil pressure indication within 30 seconds.

(3) Hydraulic pressure indication within 30 seconds.

CAUTION

To prevent engine overtemp, abort start and troubleshoot if EGT is rapidly climbing past 600°C or exceeds 705°C.

If flames or torching occurs in engine exhaust duct during start attempt, continue to clear residual fuel and monitor engine instruments to establish limits.

h. At 10 percent RPM, depress and hold IGN button while moving throttle above IDLE then back to IDLE detent. Observe oil pressure indication as specified in table 2-2. Record start fuel flow.

CAUTION

If engine fire and/or overheat light illuminates during starting, shut down engine and motor engine for 20 seconds.

NOTE

If engine does not light after advancing throttle or engine does not continue to accelerate after lightoff, discontinue start and investigate.

i. Release IGN button when EGT rises. Observe EGT limits as specified in figure 2-9.

j. At 45 percent RPM, signal observer to move air outlet valve switch OFF.

k. Allow engine to stabilize at IDLE.

WARNING

To avoid injury, ensure personnel are clear of auxiliary air doors and speed brakes prior to placing generator control switches ON.

CAUTION

During starts with outside temperature near or below freezing, allow oil to warm up and oil pressure to drop below 50 psi before placing generator control switches ON. This will avoid possible GEN/CSD damage.

l. Move L GEN or R GEN switch ON.

(1) LH or RH GEN OUT warning light goes out.

(2) BUS TIE OPEN warning light goes out.

NOTE

Repeat start procedure for other engine if both engines are to be checked.

Electrical power core may remain connected during maintenance operations when aircraft is properly restrained.

m. Disconnect external electrical power, if required.

n. Depress MASTER CAUTION RE-SET switch.

(1) MASTER CAUTION light goes out.

o. Close canopies, if required.

WARNING

Never attempt to load a cartridge with any electrical power applied, or with engines operating. A malfunction could result in cartridge ignition during the installation process.

To avoid injury do not try to uncouple air delivery hose while air delivery is taking place.

Air delivery hose is hot. Use gloves to uncouple hose from aircraft.

p. Disconnect air delivery hose from aircraft and install cap on starter inlet duct.

q. Secure doors 78, 80, 138 and 139.

2-22. ENGINE STARTING (CARTRIDGE MODE).

2-23. CARTRIDGE START DUTY CYCLE.

Consecutive cartridge starts are limited to two within a 60 minute period, with a minimum interval of 5 minutes between starts. If cartridge starts are separated by a pneumatic start, the total number of starts are limited to three in any 15 minute period.

2-24. Cartridge Burn Time.

The Starter cartridge will burn approximately 18.5 seconds when ambient temperature is 59°F.

WARNING

To prevent injury to personnel, ensure doors 138 and 139 are open and doors 78 and 80 are closed prior to removal of live, hangfire, or misfired cartridge.

2-25. Cartridge Hangfire.

A hangfire or hangstart is a condition where the engine fails to accelerate in a normal manner after initiation of a cartridge start. A hangfire is a cartridge malfunction causing the main propellant grain either not to burn or to only partially ignite. Cartridge ignition is evidenced by a small amount of smoke at the starter exhaust duct and engine rotation at low rpm. When the main propellant grain partially ignites, it may smolder until enough pressure is built up in the starter breech for complete ignition to occur. When this type of hangfire occurs, move the throttle to off and release the ignition button. The operator should remain alert for complete cartridge ignition to readvance the throttle and depress the ignition button when sustained engine rotation is assured. If the main propellant grain fails to ignite, abort the start by moving the throttle to off, release the ignition button and move the engine master switch to off. A hangstart is a cartridge start that produces engine rotation but does not provide sufficient energy to enable the engine to accelerate to idle rpm. Inasmuch as the symptoms of hangfires and hangstart are similar and often difficult to distinguish between, a common procedure is provided for both types of malfunction.

WARNING

Wait at least 5 minutes after all evidence of cartridge burning or engine rotation has ceased before opening the cartridge breech. Remove the cartridge from the starter breech (refer to paragraph 2-32). Perform a pneumatic start (refer to paragraph 2-21). If the pneumatic start is accomplished satisfactorily:

a. Inspect the cartridge breech for damage (refer to TO 2JA3-30-6 or TO 2JA3-38-6).

b. Load a new cartridge in the starter (refer to paragraph 2-27).

c. Attempt a second cartridge start. If the pneumatic start or the second cartridge start attempt is unsuccessful, remove the starter and inspect it in accordance with TO 2JA3-30-6 or TO 2JA3-38-6.

2-26. **Cartridge Misfire.** A misfire is defined as a failure of the cartridge igniter squib to fire. This may be caused by either a failure of the electrical ignition system, failure of the cartridge squib, or no contact of the cartridge ground clips. A misfire may be detected by the complete absence of engine rotation and smoke at the starter exhaust door. When a misfire develops, abort the start by moving the throttle OFF, releasing the ignition button and moving the ENGINE MASTER switch OFF. Wait at least 5 minutes before attempting to remove the misfired cartridge. Do not attempt to remove a cartridge with the other engine running. Remove the misfired cartridge, using asbestos gloves, and assure the ground clips have been bent up sufficiently to make contact. Check to see if the safety clip has been removed. Reload the starter and again initiate the start procedure.

2-26A. Deleted.

2-27. STARTER CARTRIDGE LOADING. See figure 2-5.

2-28. Materials.

Cloth, wiping
Soda, bicarbonate technical
Cartridge, starter

2-29. Manpower Requirements.

a. **Two men required.**

2-30. Procedure.

WARNING

Never attempt to load a cartridge with any electrical power applied, or with engines operating. A malfunction could result in cartridge ignition during the installation process.

a. Ensure ENGINE START switch and LEFT and RIGHT ENGINE MASTER switches are OFF.

WARNING

To prevent injury to personnel, make sure safety struts are installed on door 81L and R actuators.

b. Open doors 138, 139 and 140 and install safety strut on door 81R. Close doors 78 and 80.

c. Remove breech cap by pulling disconnect handle up to clear lug on breech chamber then turning clockwise.

CAUTION

Ensure carbon residue and other foreign matter is removed.

d. Clean inside of breech cap and fixed breech dome sealing surface with water dampened cloth (wipe dry).

e. Remove cartridge from container and inspect for serviceability. Visually inspect the cartridge seal area for damage and obvious flaws. Refer to TO 11A18-13-7.

CAUTION

Rotation of the cartridge after installation in starter breech cap of more than 45 degrees from original position will possibly ground the firing pin contact of the MXU—4A/A cartridge, part No. 4751000, thereby causing misfire.

f. *Remove shortcut clip or bend shortcut clip away from center.*

g. Set cartridge down, dome end up, and slip breech cap over cartridge.

h. Turn breech cap over with cartridge inside.

i. Position breech cap on starter and engage lugs. Pull disconnect handle on electrical connector until handle clears lug on breech chamber and turn breech cap until connectors align. Release handle.

j. Install cartridge in other starter breech.

CAUTION

Ensure pneumatic inlet duct cap is installed to prevent possible heat damage to aircraft.

k. Close door 140.

CAUTION

To prevent heat damage to aircraft, ensure doors 78 and 80 exhaust deflectors are fully extended.

l. Open doors 78 and 80. Close doors 138 and 139.

WARNING

Stay clear of starter exhaust area. Hot gases can cause serious injury.

m. Cartridges are now loaded and engines ready to start. Remove safety strut from door 81R.

n. *After cartridges have fired and engines are running with generators on line, close doors 78 and 80.*

2-31. STARTING.

WARNING

Never attempt to load a cartridge with any electrical power applied, or with engines operating. A malfunction could result in cartridge ignition during the installation process.

CAUTION

After four consecutive cartridge starts, accomplish a pneumatic start or pneumatic motoring for at least 20 seconds. Continuous cartridge starts result in excessive carbon buildup and possible starter failure.

To avoid engine damage, allow oil to warm up and oil pressure to drop below 50 psi before placing generator control switches ON. This will prevent possible GEN/CSD damage.

Ensure cap is installed on pneumatic inlet duct before initiating a cartridge start. If cap is not in place, heat damage to aircraft can result.

Do not punch holes in Milar seal under cartridge screen. This could cause unsatisfactory cartridge ignition.

NOTE

Pneumatic inlet door must be closed when performing cartridge start.

Pneumatic mode is primary starting mode for all normal operations.

Cartridge starts may be aborted by releasing ignition button and moving throttle and ENGINE MASTER switch OFF.

Consecutive cartridge starts are limited to two within a 60 minute period, with a minimum interval of 5 minutes between starts. If cartridge starts are separated by a pneumatic start, the total number of starts are limited to 3 in any 15 minute period.

The starter cartridge will burn approximately 18.5 seconds when ambient temperature is 59°F.

Cartridge manufacted by Talley Industries is more susceptible to torching than the Olin.

Cartridges stowed as spares aboard aircraft will be handled in accordance with T.O.11A18—13 —7. Excessive temperature cycling will adversely affect cartridge operation.

a. Place LEFT and RIGHT ENGINE MASTER switch ON.

b. Place L GEN and R GEN switch ON. Advance right throttle above IDLE then back to IDLE detent.

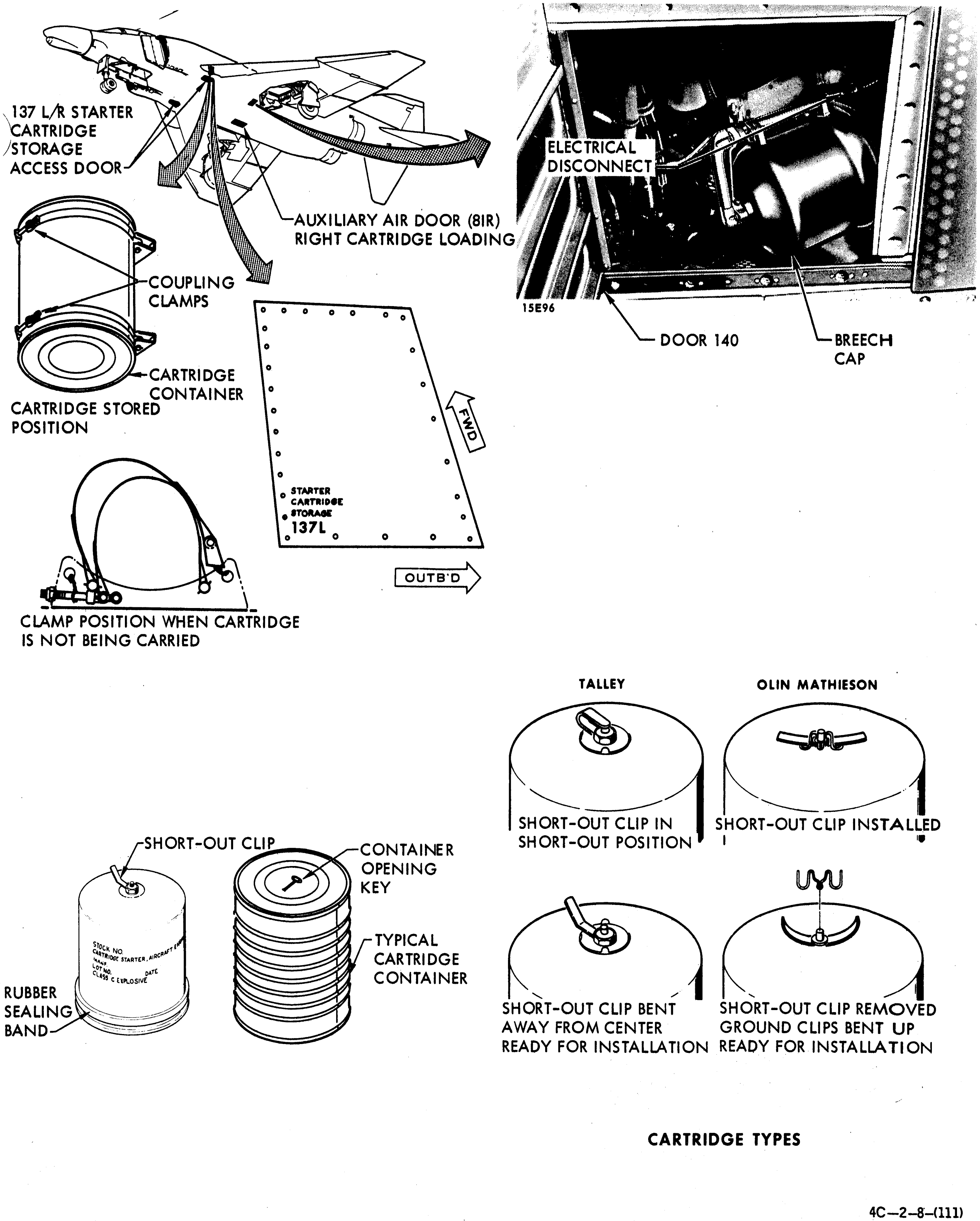


Figure 2-5. Cartridge Loading Instructions

NOTE

If engine fails to light or does not accelerate, discontinue start by moving throttle OFF and ENGINE MASTER switch OFF.

c. Hold right IGN button and momentarily actuate ENGINE START selector switch to R.

d. Release IGN button when EGT rises.

e. Advance left throttle above IDLE then back to IDLE detent.

CAUTION

If EGT exceeds 705°C, abort start and troubleshoot to prevent reoccurrence.

If EGT is rapidly climbing past 600°C, move throttle to OFF to prevent overtemperature.

If EGT stabilizes at any temperature and RPM stagnates below IDLE, discontinue start cycle and troubleshoot.

NOTE

If engine fails to light or does not accelerate, discontinue start by moving throttle OFF and ENGINE MASTER switch OFF.

f. Hold left IGN button and momentarily actuate ENGINE START selector switch to L.

g. Release IGN button when EGT rises.

WARNING

To avoid possible inflight ignition, do not install cartridge after engine start.

h. *Close doors 78 and 80.*

i. Remove spent cartridge after flight. Refer to paragraph 2–32.

2–32. STARTER CARTRIDGE REMOVAL.

2–33. Materials.

Steel wool
Cloth, wiping
Soda, bicarbonate technical

2–34. Procedure.

WARNING

To prevent injury to personnel, make sure safety struts are installed on door 81L and R actuators.

a. Open door 140 and install safety strut on door 81R.

WARNING

Use asbestos gloves when removing cartridge to keep from burning hands.

b. Remove breech caps by pulling disconnect handle up to clear lug on breech chamber then turning clockwise.

c. Cartridge will normally drop from breech; however, if it sticks, tap breech cap lightly against wood block.

d. *After breech caps have cooled, clean inside of breech caps and breech chamber with non metallic scouring pad. Wipe clean with cloth dampened in bicarbonate of soda solution.*

e. *Replace breech caps on starter.*

f. *Close door 140 and remove safety strut from door 81R.*

2–35. STARTER CARTRIDGE STORAGE. See figure 2–5.

2–36. Materials.

Lockwire, MS20995NC32

2–37. Removal.

a. Remove doors 137 L and R.

b. Loosen nuts on couplings holding containers and remove.

c. *Secure couplings with lockwire.*

d. *Close doors 137 L and R.*

2–38. Installation.

a. Remove doors 137 L and R.

b. Remove lockwire stowing couplings.

c. *Place cartridge containers in racks and fasten couplings. Torque nuts 12 to 15 inch–pounds.*

d. *Close doors 137 L and R.*

2-38A. ENGINE SHUTDOWN.

CAUTION

Following engine shutdown, if fuel ignites in engine exhaust duct, motor engine with throttles in OFF position until residual fuel and fire is cleared. Do not extinguish fires with chemical extinguishes unless absolutely necessary, as engine corrosion may result. If chemicals other than CO_2 or Halon 12-11 are used, wash, preserve and return engine to overhaul. However, if CO2 is used exclusively and the engine has not been subjected to fire damage, no action is required.

NOTE

Emergency engine shutdown procedures are given in paragraph 2-19A.

a. Cool engine at IDLE for 3 minutes.

NOTE

Ensure friction lever is full aft.

b. Move throttle to OFF.

c. Move ENGINE MASTER switch to OFF.

2-39. Deleted.

2-40. CHECKOUT PROCEDURE.

Procedure	Normal Indication	Remedy for Abnormal Indication
1. PRELIMINARY PROCEDURE.		
a. Perform para 2-8 thru 2-21.		
b. If hold back assembly is required, perform the following:		
(1) Move forward wheel chocks away from wheels and let aircraft roll forward by applying moderate engine power to remove slack in holdback assembly.		
(2) While tension is applied, place chocks at rear of main landing gear wheels so aircraft will not roll back when power is reduced.		
(3) Fit forward chocks against wheel.		
(4) Return throttle to IDLE.		

CAUTION

If engine is to be restarted within 30 to 120 minutes after shutdown, vibration above normal may occur due to thermal inbalance of the compressor rotor. If this condition is experienced, run engine at 85 percent for 1 to 1 1/2 minutes. Vibration should return to acceptable limits. If excessive vibration continues, shut down engine and take corrective action.

To prolong engine life, avoid unnecessary rapid throttle movement. Rapid throttle movement causes excessive thermal cycling and turbine section deterioration.

Procedure	Normal Indication	Remedy for Abnormal Indication
2. IDLE CHECK.		
a. Check indicators.	EGT 220° to 420°C	If other indications are normal, replace indicator.
	Fuel flow 800 to 1400 pph	If other indications are normal, replace indicator.
	RPM 64 to 66 percent	Refer to para 2-114.
	Oil pressure, 12 psi minimum.	Refer to para 2-102.

NOTE

Nozzle position is for reference only and is not cause for rejection if EGT and fuel flow are acceptable.

Procedure	Normal Indication	Remedy for Abnormal Indication
	Nozzle position 7/8 to 3/4 open	Refer to para 2-66
b. Close canopy(s), if required.	Fuel boost pump pressure, 25 to 35 psi.	Refer to TO 1F-4C-2-10.
c. Have observer check for fluid leaks.	No leaks visible	Correct cause of leakage before advancing to higher power settings.

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
3. POWER CHECK.		
NOTE If both engines are to be checked, run up one engine, retaining other engine at IDLE. EGT and RPM adjustments when required, will be made to nominal line.		
a. Check MFC vernier reference marks for alignment or MFC IDLE notch for alignment with rig pin port.	MFC vernier reference marks are aligned or IDLE notch is aligned in rig pin port.	Check throttle rigging, if outer slider adjustment is required rerig system. Perform Airframe Power Plant Control System Rigging, refer to para 4-115.
b. With throttle lever at IDLE, note fuel flow and engine RPM.		
c. Attach torque wrench and adapter to outboard end of MFC crossover shaft and apply 30 inch-pounds torque in direction of cutoff and hold for 30 seconds.	Fuel flow decreases less than 100 pph and RPM decreases less than 1 percent from values obtained in step b.	1. Repeat step a. 2. Ensure idle adjustment screw is contacting MFC cam. 3. Perform Airframe Power Plant Control System Wear Check, refer to para 2-52A.
d. Remove torque wrench and advance throttle to approximately 80 percent.		
e. Move ENGINE ANTI-ICING switch to DE-ICE.	L ANTI-ICE or R ANTI-ICE ON light comes on.	Refer to para 2-86.
	Slight increase in EGT.	Refer to para 2-86.
f. Return ENGINE ANTI-ICING switch to NORMAL.	L ANTI-ICE or R ANTI-ICE ON light goes out.	Replace anti-icing indicator switch if EGT returns to normal. Refer to TO 2J-J79-46.
	EGT returns to normal	Replace anti-icing valve. Refer to TO 2J-J79-46.
g. Advance throttle until EGT stabilizes at maximum temperature.	EGT 615° to 635°C	High EGT, refer to para 2-90. Low EGT, refer to para 2-89.
h. Advance throttle to MIL and stabilize.	Nozzle starts close at 66 to 68 percent	Refer to para 2-66.
	Cam notch on low side of cam, 1/2 hole, or vernier reference mark 1/16 to 3/32 inch below MIL.	Adjust MIL stop as required. Refer to para 4-120, step 3.
	EGT 615° to 635°C (See fig 2-11)	High EGT, refer to para 2-90 Low EGT, refer to para 2-89.

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
3. POWER CHECK. (Cont.)		
	RPM 99.5 to 100.5 percent. (See fig 2-11)	Refer to para 2-106.
	Oil pressure +5 -10 of placard value.	High oil pressure, refer to para 2-101. Low oil pressure, refer to para 2-102.
	Exhaust nozzle position approximately 1/2 to 1/4 closed.	Refer to para 2-66.
	Fuel flow within limits of fig 2-14.	Perform fuel flow indicator system checkout. Refer to TO 1F-4C-2-11. If indicator system is functioning properly, replace main fuel control. Refer to section V.
	Hydraulic pressure Utility (both engines operating) 2750 to 3250 psi. Utility (left engine operating) 2750 to 3250 psi. Utility (right engine operating) 2550 to 3000 psi. PC I 2750 ti 3250 psi. PC II 2750 to 3250 psi.	Refer to TO 1F-4C-2-6
i. With throttle lever positioned at MIL, check for indication of AB light from both front and rear cockpits. Apply 7 to 10 pounds force forward to aft cockpit throttle lever.	Afterburner does not light.	Repeat step h above and then check for loose rod end bearing in door 9L.
j. Have observer check for external fluid leaks.	No leaks visible.	Replace defective seal or component.

NOTE

Ensure flaps are up.

Procedure	Normal Indication	Remedy for Abnormal Indication
k. Retard throttle to IDLE and check gages on idling engine. (Bleed air check valve checkout)	RPM not over 67.5 percent EGT reduction less than 20°C. Fuel flow reduction less than 50 pph.	Replace bleed air check valve on idling engine. Refer to section XIII.

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
4. ACCELERATION - DECELERATION CHECK.		

CAUTION

To avoid engine damage if compressor stalls, retard throttle to IDLE. If necessary, shut down engine to break stall.

To prolong engine life, avoid unnecessary rapid throttle movement. Rapid throttle movement causes excessive thermal cycling and turbine section deterioration.

NOTE

Make acceleration and deceleration checks from forward cockpit.

Procedure	Normal Indication	Remedy for Abnormal Indication
a. Advance throttle to MIL.		
b. Rapid deceleration to 90 percent.		
c. Rapid acceleration to MIL.	EGT 615° to 635°C (see fig 2-11)	High EGT, refer to para 2-90. Low EGT, refer to para 2-89.
	RPM 99.5 to 100.5 percent. (see fig 2-11)	Refer to para 2-106.
	No tendency to stall	Refer to para 2-87.
d. Rapid deceleration to 80 percent.		
e. Rapid acceleration to MIL.	No tendency to stall.	Refer to para 2-87.
f. Rapid deceleration to IDLE.	Minimum fuel flow 225 pph.	Perform fuel flow indicator system checkout. Refer to TO 1F-4C-2-11. If indicator system is functioning properly, perform throttle rigging check. Refer to para 2-54. If throttle is properly rigged, replace main fuel control. Refer to section V.
	Fuel flow does not drop below start fuel flow as recorded in para 2-21.	Repeat idle check and perform airframe power plant control system wear check, refer to para 2-52A.
	RPM 64 to 66 percent.	Adjust RPM, refer to para 4-133.
g. Rapid acceleration to MIL.	No tendency to stall.	Refer to para 2-87.
	Acceleration time, see fig 2-15	Refer to para 2-91.

CAUTION

To prevent throttle system damage, limit force when chopping throttle from rear cockpit to 10 pounds.

Procedure	Normal Indication	Remedy for Abnormal Indication
h. Rapid deceleration to IDLE from rear cockpit.	Minimum fuel flow 225 pph.	Rig throttle. Refer to section IV.

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
5. AFTERBURNER CHECK		
NOTE During afterburner operation, oil pressure may increase slightly. This is a normal condition.		
a. Advance throttle to min AB.	Smooth afterburner light within 3 seconds	Refer to para 2-84
	No increase in fuel flow.	Adjust mil stop plate and max trim screws, refer to fig 4-19
	Maximum RPM rollback to 87 percent and recover within 12 seconds.	Refer to para 2-95.
	EGT 615° to 635°C (see fig 2-11)	High EGT, refer to para 2-96. Low EGT, refer to para 2-89.
b. Advance throttle to MAX.	Afterburner modulates with no tendency to stall, overtemperature, or overspeed.	Refer to para 2-94.
	No RPM increase.	Refer to para 2-107.
	Nozzle position 5/8 to 7/8 open.	Refer to para 2-97.
c. Slowly retard throttle to min AB.	Afterburner modulates with no tendency to stall, overspeed, or overtemperature.	Refer to para 2-94.
d. Retard throttle to MIL.	Afterburner terminates within 3 seconds.	Refer to para 2-85.
e. Advance to min AB.	Smooth afterburner light within 3 seconds.	Refer to para 2-84.
f. Rapid acceleration to MAX.	Afterburner modulates with no tendency to stall, overtemperature, or overspeed.	Refer to para 2-94.
	Exhaust nozzle position 5/8 to 7/8 open.	Refer to para 2-97.
g. Rapid deceleration to IDLE. As RPM drops to 80 percent, rapid acceleration to MIL.	No tendency to stall.	Refer to para 2-87.
h. Retard throttle to IDLE.		
i. Allow engine to stabilize at IDLE and then apply 7 to 10 pounds pressure to aft cockpit throttle lever in direction of off.	Fuel flow and RPM do not decrease.	Repeat idle check, step 2.

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
6. SHUTDOWN.		
a. If holdback assembly is installed, perform the following:		
(1) Apply moderate power and let aircraft roll forward.		
(2) Move wheel chocks to the rear of main gear tires, to allow holdback assembly to touch ground.		
(3) Retard throttle to IDLE and allow aircraft to roll back against chocks.		
b. Cool engine at IDLE for 3 minutes.		

CAUTION

Following engine shutdown, if fuel ignites in engine exhaust duct, motor engine with throttles in OFF position until residual fuel and fire is cleared. Do not extinguish fires with chemical extinguishes unless absolutely necessary, as engine corrosion may result. If chemicals other than CO_2 or Halon 12-11 are used, wash, preserve, and return engine to overhaul. However, if CO_2 is used exclusively and the engine has not been subjected to fire damage, no action is required.

Procedure	Normal Indication	Remedy for Abnormal Indication
c. Move throttle to OFF.	Engine shutdown	Refer to para 2-19A
	Fuel dump start within 5 seconds.	Replace pressurizing and drain valve. Refer to section V.
d. Move L GEN or R GEN switch OFF.		
e. Move LEFT or RIGHT ENGINE MASTER switch OFF.	No unusual noises during coastdown.	Refer to section XII.
f. Turn UHF comm off by setting VOL to 0.		

WARNING

To avoid injury to personnel, do not uncouple air delivery hose from aircraft while air delivery is taking place.

Use gloves to uncouple air delivery hose from aircraft.

Procedure	Normal Indication	Remedy for Abnormal Indication
g. Disconnect air delivery hose from aircraft and install starter cap on aircraft pneumatic inlet nipple.		
7. POST OPERATION PROCEDURE		
a. Perform the following:		
(1) Ensure fuel control is off.		

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
7. POST OPERATION PROCEDURE (Cont.) NOTE Service engine oil tanks as soon as possible but not to exceed 30 minutes after shutdown. If engine is not serviced within 30 minutes, motor engine in pneumatic mode for 1 minute prior to servicing. *(2) Service oil tank.* WARNING Stay clear of exhaust nozzle for 15 minutes after shutdown and when vapors are seen coming from nozzle. Vapors may be highly explosive.		
(3) Check nozzle segments for cracks, distortion and missing parts. *(4) Reset bellmouth pitot heater, oxygen gage, ramp control and AOA probe circuit breakers.* *(5) Perform foreign object inspection and close doors 78, 80, 138 and 139.* *(6) Complete engine runup data record, AFTO 781N.*		

2-41. EXTREME CLIMATIC AND ENVIRONMENTAL INFORMATION.

2-42. The J79 engine is designed to operate at outside temperatures ranging from −65° to 160°F. However, when the engine is operated under conditions of extreme cold or heat, the following general precautions should be taken.

2-43. ARCTIC OPERATION.

CAUTION

Engine inlet and inlet screens can accumulate ice during operation when dew point is approximately 40°F or below. If ice forms, shut down engine. Ingested ice can cause FOD.

a. Before Starting:

(1) Manually rotate compressor rotor to assure engine is not frozen.

(2) Use ground heater units to preheat engine when engine is frozen.

(3) Inspect all drains to assure normal drainage.

(4) Repair fuel and oil leaks in a warm hangar, whenever possible, to assure proper sealing of packings and tubing connectors.

b. Ground Operation, Icing Conditions:

(1) Use normal starting procedures.

CAUTION

Rapid throttle movements with possible ice accumulation in compressor could result in stall.

(2) Make throttle movements cautiously.

(3) Do not operate below 82 percent for more than 5 minutes.

(4) Operate at MIL for at least 30 seconds after each period below 82 percent.

NOTE

When aircraft have been parked with flaps down in freezing temperatures, it is permissible to accomplish engine starts with flaps down. Anticipate longer acceleration times during flaps down starts due to the volume of air required by the BLC system.

c. After Engine Shutdown:

(1) Do not install engine inlet and exhaust covers until after engine has cooled.

(2) During outside storage assure engine inlet and exhaust covers are installed to protect against rain, sleet, snow or other foreign matter.

2-44. **DESERT OPERATION.**

a. Before Starting:

(1) Assure engine inlet is free of sand, heavy dust accumulation and other foreign matter.

(2) Check all filters more frequently than during normal operation.

b. Ground Operation:

(1) Use normal starting procedures.

(2) Avoid prolonged operation in gusty or windy weather.

c. After Engine Shutdown:

(1) Park aircraft crosswind, if possible.

(2) Install engine inlet and exhaust covers.

Table 2-2. Operating Limits

Leading Particulars	Specifications
NOTE The limits shown in this table are for engine operation with the wing flaps retracted and no BLC Air Flow.	
FUEL	
a. Type	MIL-T-5624, grade JP-4 primary, grade JP-5 alternate
b. Fuel flow: At light-off During transition from light-off to IDLE At IDLE At MIL	 225 to 750 pph Up to 2400 pph 800 to 1400 pph See fig 2-14
c. Fuel flow fluctuation under 3000 pph over 3000 pph	 100 pph 750 pph
OIL	
a. Type	MIL-L-7808
b. Pressure at starting	Indication
c. Pressure at IDLE	12 psi, minimum
d. Pressure at MIL (ground operation)	35 to 60 psi At engine change or when component in lube system is changed, record oil pressure at MIL after stabilized operation for 5 minutes. Correct recorded pressure to 100 percent RPM using fig 2-16. Placard oil pressure indicator with corrected oil pressure value. MIL oil pressure, corrected to 100 percent RPM, must repeat within +5 to −10 psi of placarded value. Final check before rejection of engine for oil pressure must be made with reference to 135°F lube pump inlet oil temperature and 100 percent RPM. See fig 2-17. Corrected pressure must be 50 ±10 psi but not exceed ±5 psi of corrected pressure shown on engine oil pressure record card.

CONTINUED

Table 2–2. Operating Limits

Leading Particulars	Specifications
OIL (Cont.)	
NOTE During afterburner operation, oil pressure may increase slightly. This is a normal condition.	
e. Pressure at 100 percent RPM (flight operation)	30 to 60 psi During steady state operation, any oil pressure change that exceeds 10 psi must be investigated. During T2 cutback and other engine speed reductions, indicated pressure will decrease approximately 1 psi per 1 percent reduction in RPM.
f. Pressure surge	100 psi during cold weather starts.
g. Pressure fluctuation	±2.5 psi during steady state
h. Consumption	
first 2 hours	2 pints per hour
each additional hour	1 pint per hour 1 pint per hour is also allowed during windmilling
EXHAUST GAS TEMPERATURE. See fig 2-11.	
a. Top temperature	625° ±10°C
b. During starting	See fig 2–9.
c. All other conditions	See fig 2–10.
d. Fluctuation	
at IDLE	±3°C and/or with peaks of 5°C occuring at least every 5 seconds
IDLE to MIL	±5°C and/or with peaks of 10°C occuring at least every 5 seconds.
during afterburner	±10°C
RPM. See fig 2–11.	
a. IDLE	65 ±1.0 percent stabilized
b. MIL	100 ±0.5 percent stabilized above 4.4°C CIT.
c. Allowable overspeed	
ground operation	103 percent continuous 105 percent for 3 minutes

CONTINUED

Table 2-2. Operating Limits

Leading Particulars	Specifications
RPM. See figure 2-11. (Cont.) flight operation	102 percent continuous 103.6 percent for 1 minute
d. Speed drop off with afterburner light	to 87 percent recover within 12 seconds
ACCELERATION	
a. Idle to Military	See figure 2-15
AFTERBURNER	
a. Light off time	3 seconds maximum
b. Shut down	3 seconds maximum
LEAKAGE	
a. Total during operation	1 quart per hour maximum Limit is not to be used as basis for rejecting engine. If total overboard leakage value is exceeded, disconnect drains from individual accessories and check amount of leakage against limits that follow. If all accessories are within individual limits, engine is acceptable even though above value is exceeded.
b. Fuel drain manifold	approximately 1.6 pints at shutdown
c. P and D valve	5cc per minute during operation valve must start to drain within 5 seconds after throttle is moved to OFF 50cc per minute with engine shutdown and boost pump pressure of 35 psi.
d. Afterburner pressurizing valve (from manifolds downstream of valve)	Wetting of spray bars is permitted. Puddling of fuel in turbine frame is not permitted. 5cc per minute per manifold drain is permitted with throttle at IDLE and ENGINE MASTER switch ON.
e. Afterburner pump seal drain	60 drops per minute during operation
f. Afterburner pump vent port	25 drops per minute during operation. Continuous draining is allowed for 2 minutes after selecting afterburner. Draining must start within 10 seconds after cancelling afterburner, reduce noticeably within 4 minutes and not exceed 25 drops per minute after 15 minutes. If limits are exceeded, disconnect line from torch igniter on-off valve and recheck.
g. Main fuel control	25 drops per minute

CONTINUED

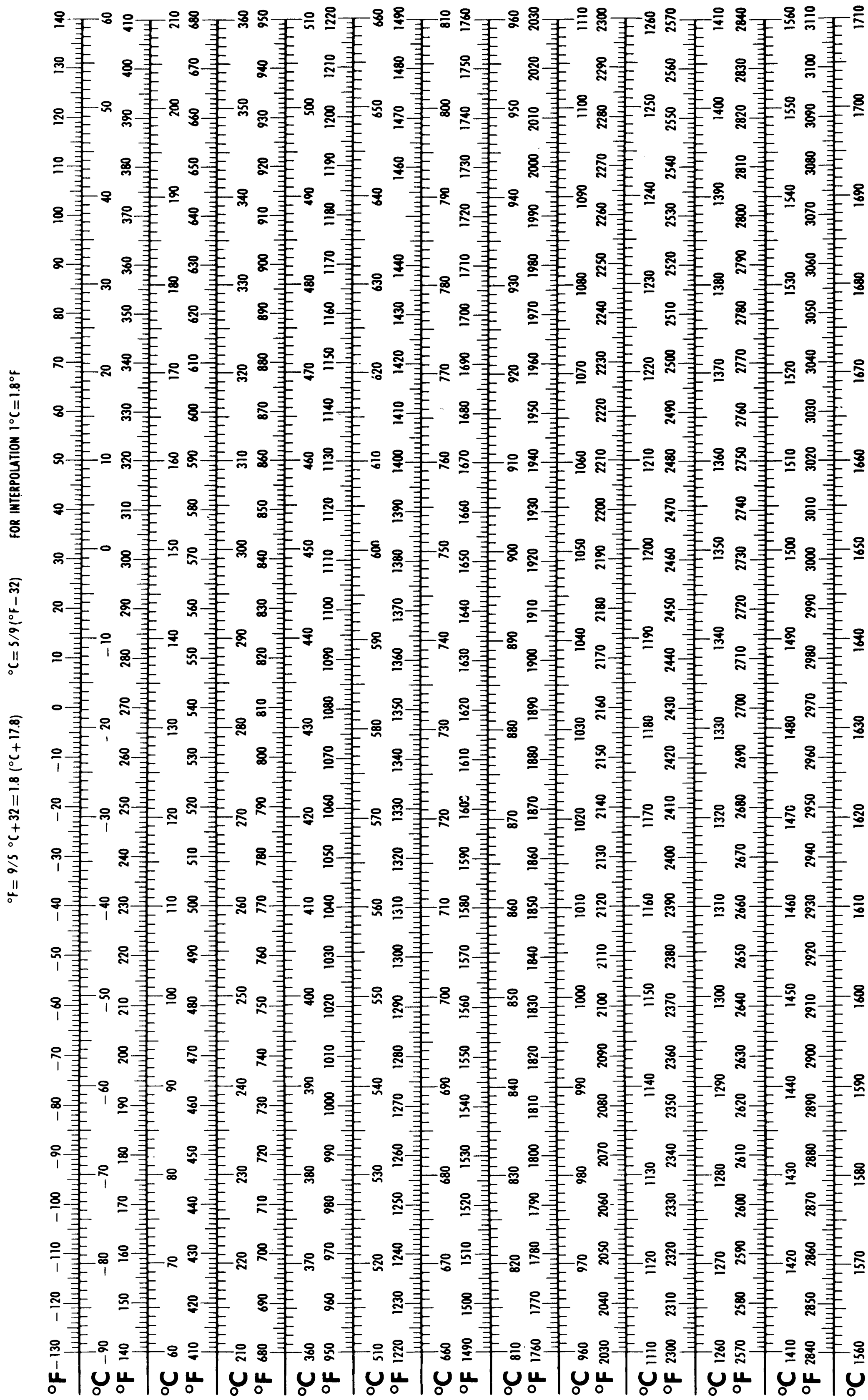
Table 2-2. Operating Limits

Leading Particulars	Specifications
LEAKAGE (Cont.)	
h. Main fuel pump seal drain	60 drops per minute. Excessive main fuel pump seal drainage can result from shutting down engine with ENGINE MASTER switch. This condition can usually be corrected by operating engine at various high power settings for several minutes, then shutting down with throttle.
i. Nozzle area control	25 drops per minute
j. IGV actuator	60 drops per minute
k. Torque booster	25 drops per minute
l. 17th stage bleed air extraction port—manifold flange face junction.	Leakage is acceptable up to four inches in any direction from the air leak source as detected at idle power setting by the back of the hand.
FUEL BOOST PUMP PRESSURE	25 to 35 psi engines not running
HYDRAULIC PRESSURE	
a. Utility (both engines operating)	2750 to 3250 psi
b. Utility (left engine operating)	2750 to 3250 psi
c. Utility (right engine operating)	2550 to 3000 psi
d. PC I	2750 to 3250 psi
e. PC II	2750 to 3250 psi
ENGINE WINDMILLING	
a. Above 40,000 feet	Limited to transient conditions during air starts.
b. Below 40,000 feet	7 percent RPM, minimum continuous. Windmilling below 7 percent is limited to 10 minutes. Number of 10 minute periods below 7 percent is not limited provided RPM is above 7 percent for 10 minutes between intervals.
OIL VAPOR/DRIPPING	
a. Compressor rear frame and turbine frame ports	Vapor is acceptable during transients provided vapor ceases within 30 seconds after reaching steady state.
b. Compressor front frame, aft face of IGV support	This limit applies only if engine ran no more than 5 minutes at IDLE immediately prior to shutdown and if engine ran for at least 3 minutes above 75 percent before last IDLE period. No leakage allowed from anti-icing holes.
Steel frame	5 drops maximum within 5 minutes after shutdown.
Aluminum frame	20 drops maximum within 5 minutes after shutdown.

CONTINUED

Table 2-2. Operating Limits

Leading Particulars	Specifications
OIL VAPOR/DRIPPING (Cont.)	
c. Turbine wheel and 6 o'clock strut of turbine frame	Oil wetting from No. 3 sump is permissible following engine shutdown provided there is no corresponding engine oil consumption.
d. Gearbox pads	2cc per hour per pad.
e. Nozzle pump	Wetness which accumulates at end plate and body split line which precipitates as leakage is not acceptable.
f. Compressor rear frame, struts 5 and 6	After 5 minute MIL run wetting is acceptable, however no drops should form. 1 drop from each strut is acceptable during 5 minute IDLE run.
g. Turbine frame, struts 3 and 4	This limit applies only when engine has been at IDLE less than 5 minutes and preceded by at least 3 minutes at MIL. Accelerate to MIL. Vapors are permissible provided they cease within 30 seconds during first minute of running at MIL. Oil wetting is permissible. If marginal results are obtained on initial check, perform additional accels, decels, and steady state operation above IDLE to assure adequate seal run in and burn off of oil accumulated in sump. Repeat check.
h. Nozzle actuator static	2 drops per minute at rod end.
G LIMITS	1. −5G or less, +10G or more (meter pegs) return engine to overhaul. 2. Above +8.5G but less than +10G, inspect IAW T.O.2J–J79–46.



4C-2-8-(3)

Figure 2-8. Temperature Conversion Chart

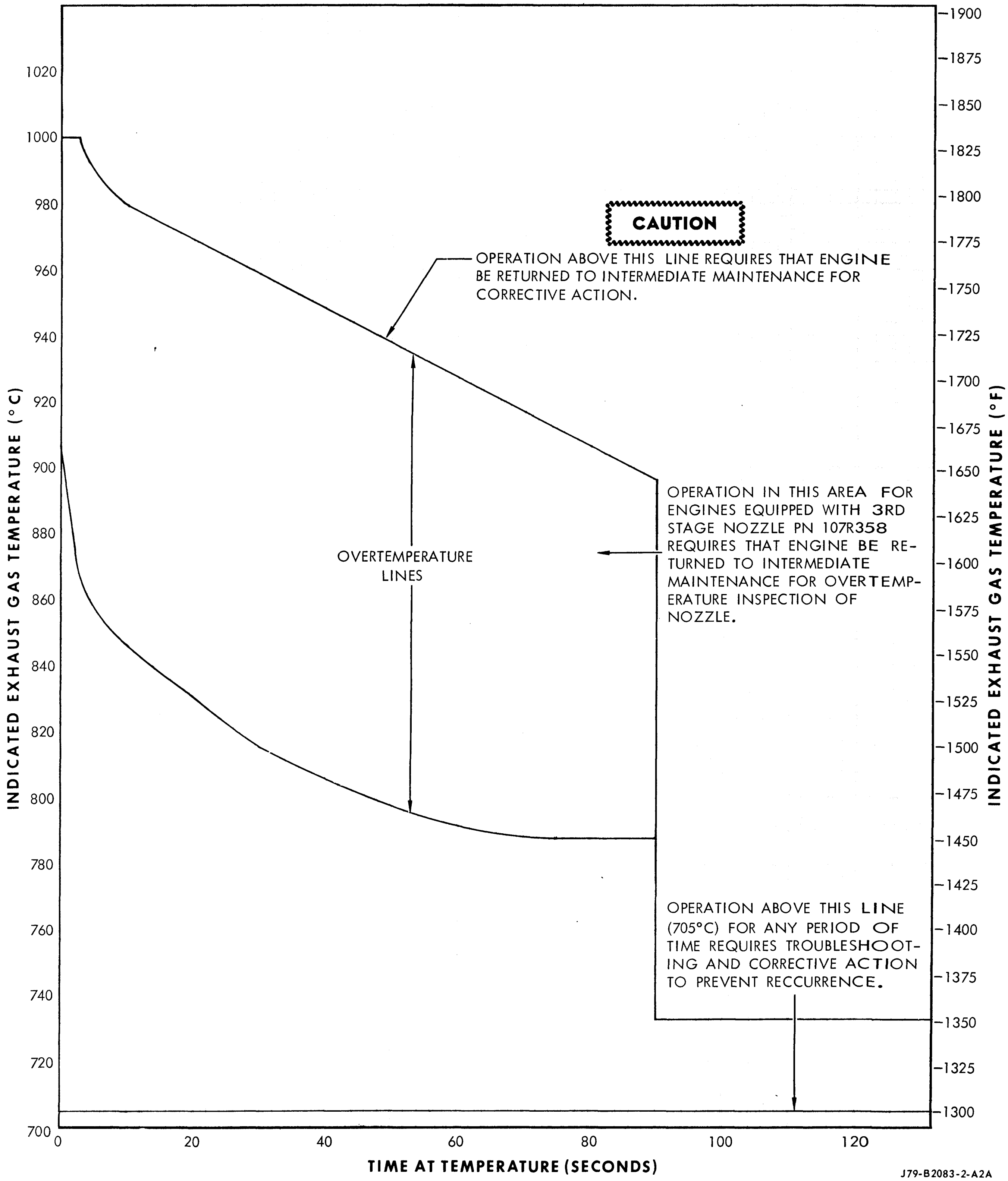


Figure 2-9. Starting EGT Limits

4C-2-8-(2)

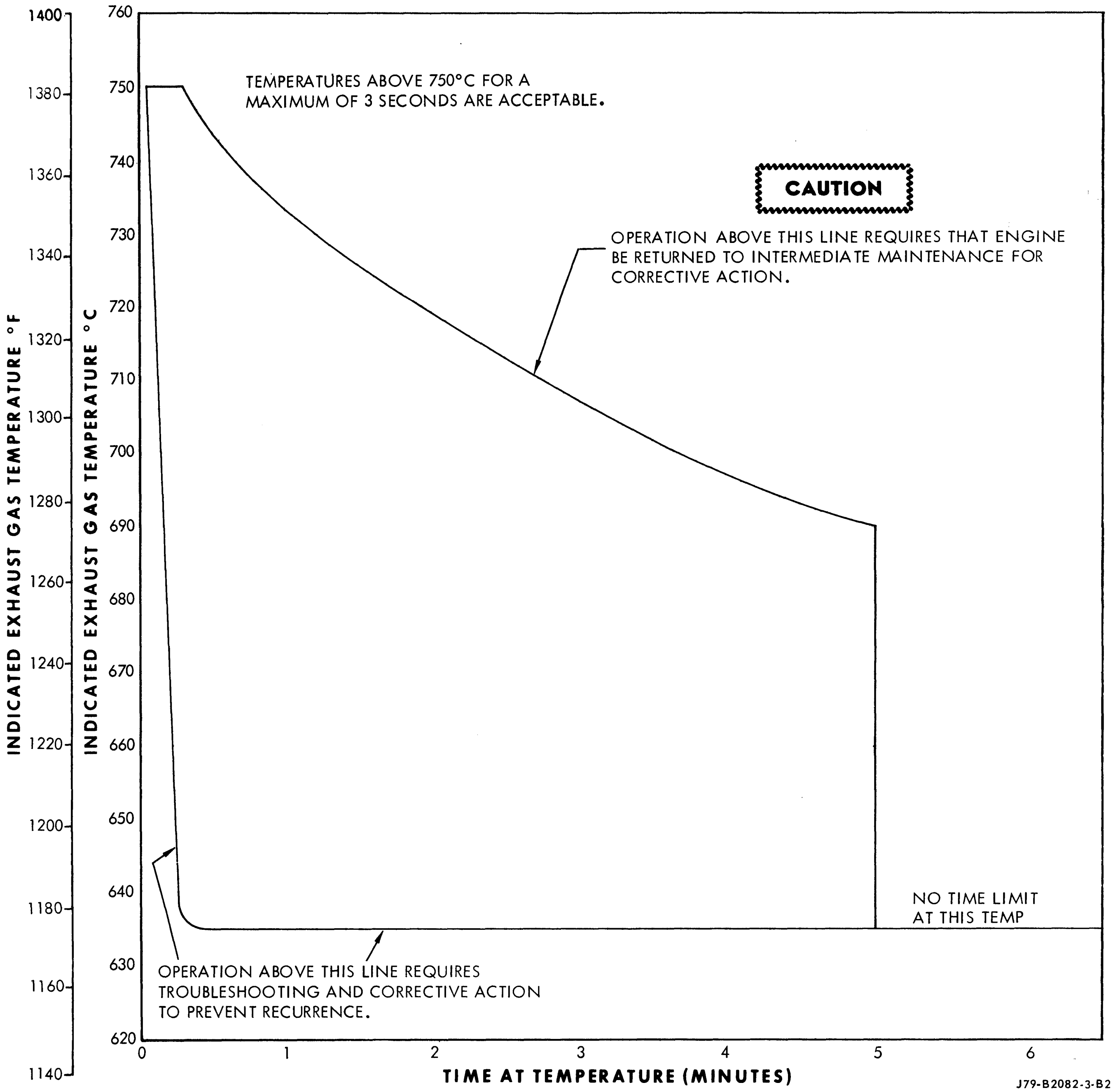
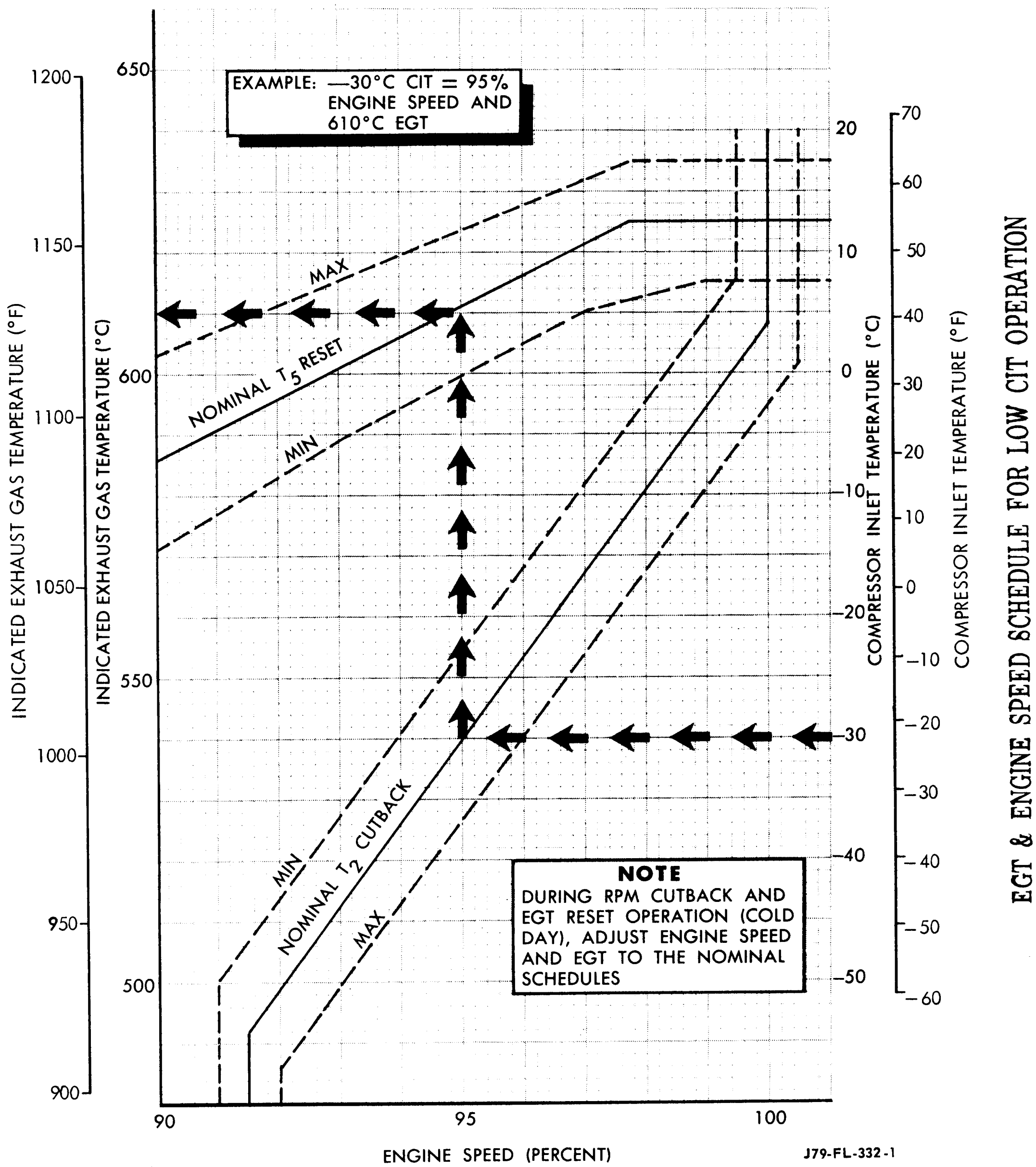


Figure 2-10. EGT Limits – All Conditions Except Starting

4C-2-8-(5



NOTE

WHEN OUTSIDE TEMPERATURE FALLS BELOW 4.4°C (40°F) ENGINE TOP SPEED WILL NOT REACH 100% RPM. WHEN MILITARY ENGINE SPEED FALLS ON SLOPE OF SPEED SCHEDULE, SET SPEED TOWARD MINIMUM LIMIT TO AVOID POSSIBLE OVERSPEED WHEN CIT INCREASES.

Figure 2-11. EGT and RPM Schedule

4C-2-8-(6)A

PERCENT ENGINE SPEED RPM											
PERCENT SPEED	RPM	PERCENT SPEED	RPM	PERCENT SPEED	RPM	PERCENT SPEED	RPM	PERCENT SPEED	RPM	PERCENT SPEED	RPM
110	8453.5	91	6993.4	72	5533.2	53	4073.1	34	2612.9	15	1152.7
109	8376.6	90	6916.5	71	5456.3	52	3996.2	33	2536.1	14	1075.9
108	8299.9	89	6840.6	70	5379.5	51	3919.3	32	2459.2	13	999.1
107	8223.0	88	6763.9	69	5302.6	50	3842.5	31	2382.3	12	922.2
106	8146.1	87	6687.0	68	5225.9	49	3765.6	30	2305.5	11	845.3
105	8069.2	86	6610.1	67	5149.0	48	3688.9	29	2228.6	10	768.5
104	7992.4	85	6533.2	66	5072.1	47	3612.0	28	2151.9	9	691.6
103	7915.6	84	6456.4	65	4995.2	46	3535.1	27	2075.0	8	614.9
102	7838.7	83	6379.6	64	4918.4	45	3458.2	26	1998.1	7	538.0
101	7761.8	82	6302.7	63	4841.6	44	3381.4	25	1921.2	6	461.1
100	7685.0	81	6225.8	62	4764.7	43	3304.6	24	1844.4	5	384.2
99	7608.2	80	6149.0	61	4687.8	42	3227.7	23	1767.6	4	307.4
98	7531.4	79	6071.1	60	4611.0	41	3150.8	22	1690.7	3	230.6
97	7454.4	78	5994.4	59	4534.1	40	3074.0	21	1613.8	2	153.7
96	7377.6	77	5917.5	58	4457.4	39	2997.1	20	1537.0	1	76.8
95	7300.8	76	5840.6	57	4380.5	38	2920.4	19	1460.1		
94	7223.9	75	5763.7	56	4303.6	37	2843.5	18	1383.4		
93	7147.0	74	5686.9	55	4226.7	36	2766.6	17	1306.5		
92	7070.2	73	5610.1	54	4149.9	35	2689.7	16	1229.6		

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4C–2–8–(7)

Figure 2–12. Engine Speed Data

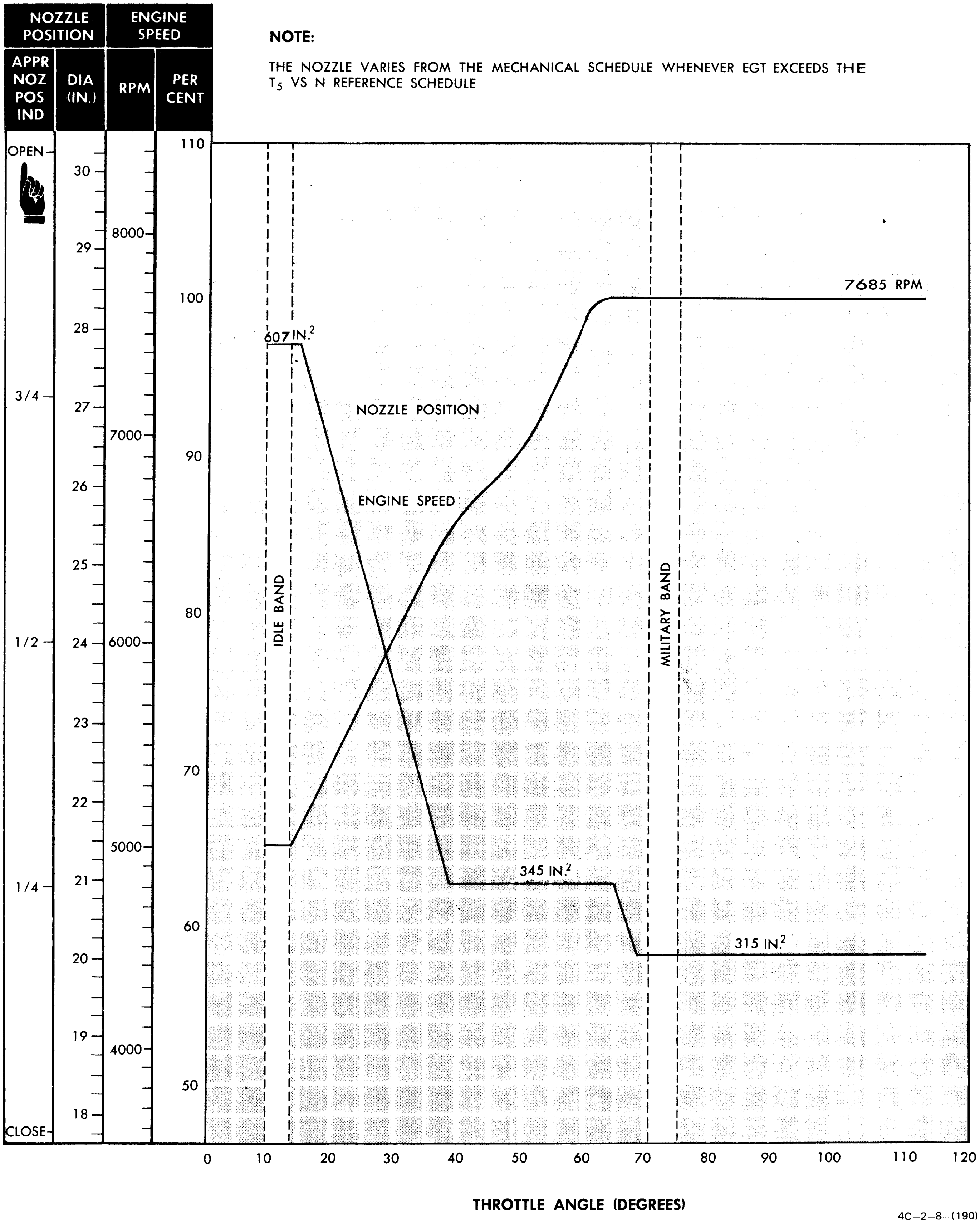
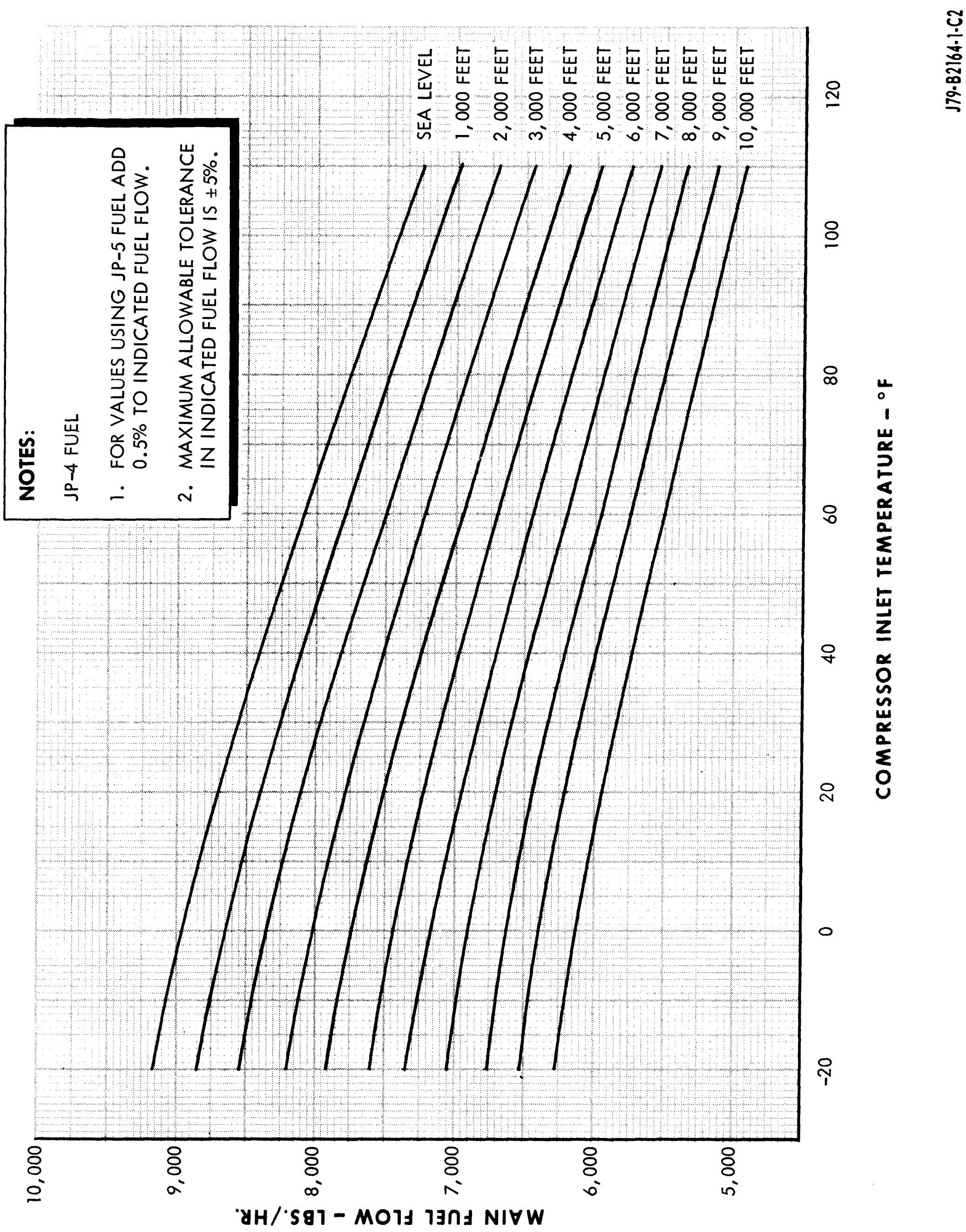
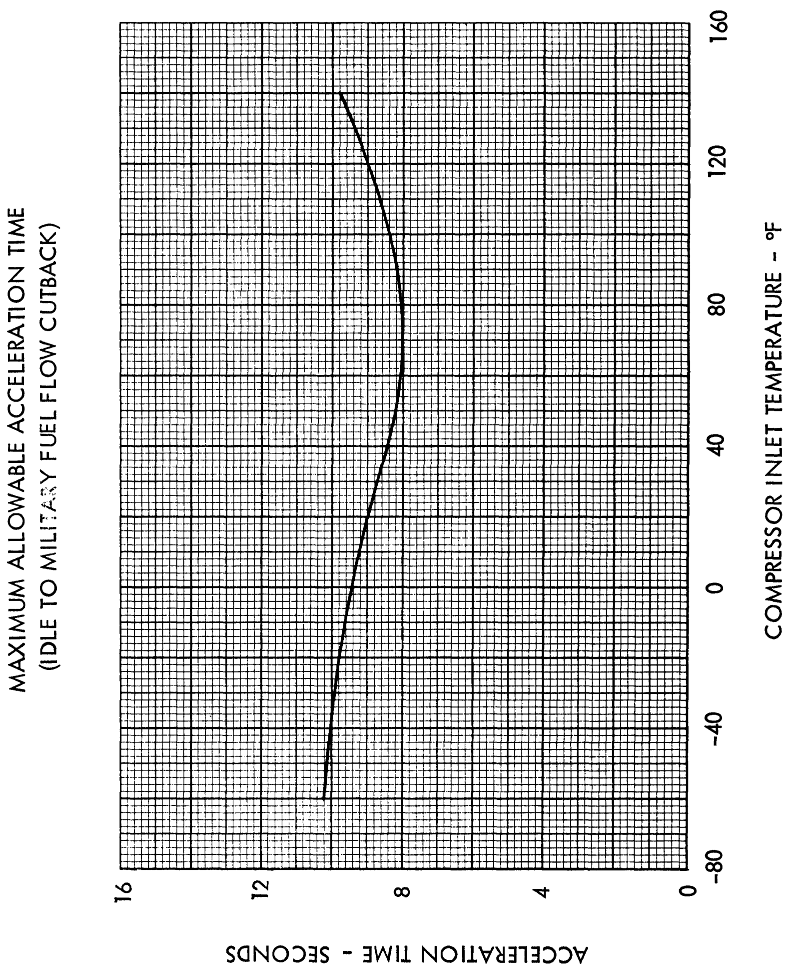


Figure 2-13. Throttle Schedule



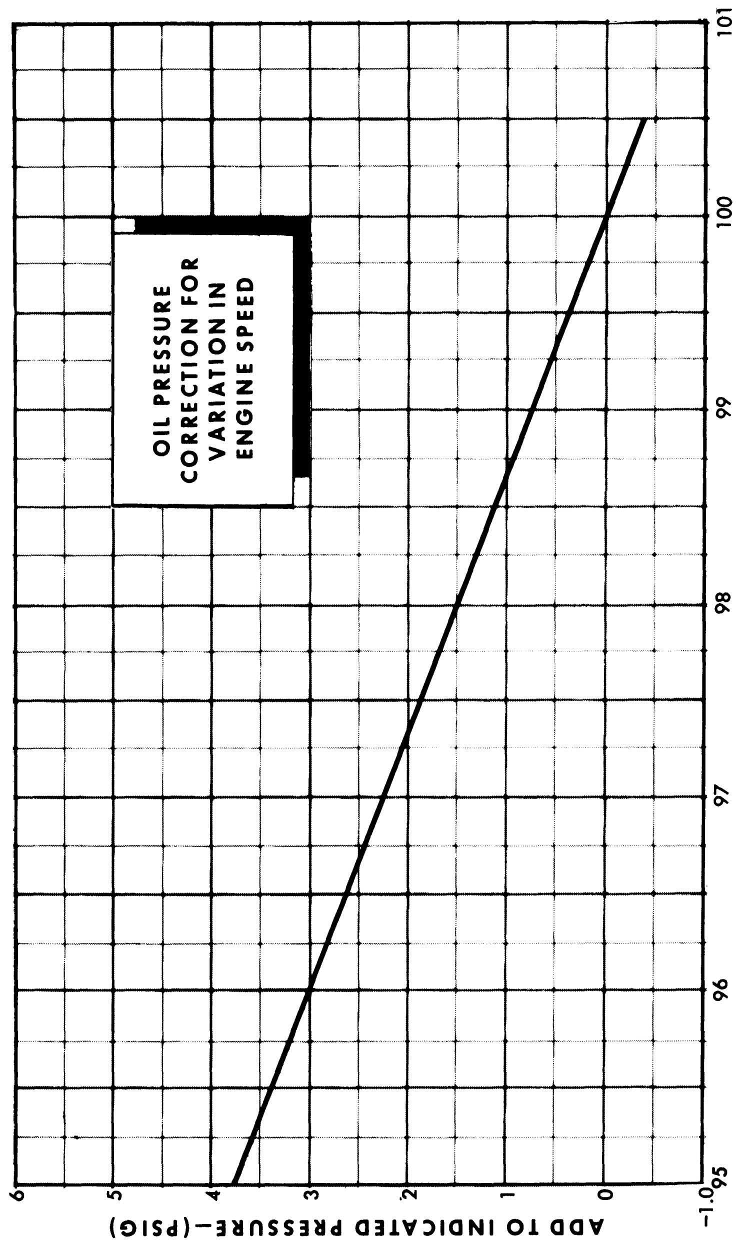
4C-2-8-(11)

Figure 2-14. Military Fuel Flow



4C-2-8-(187)

Figure 2-15. Ground Acceleration Time Limits



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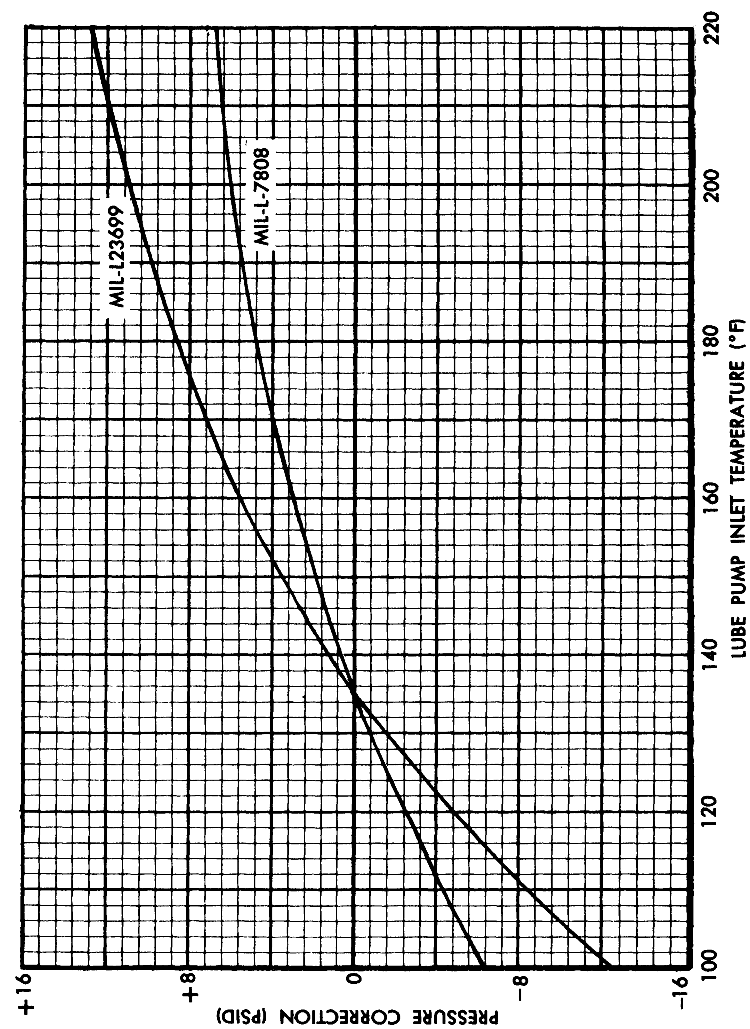
4C-2-8-(10)

Figure 2-16. Oil Pressure Correction for Variation in Engine Speed



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4C–2–8–(9)

Figure 2–17. Oil Pressure Correction for Variation in Oil Temperature

2-45. POST OPERATION PROCEDURES.

a. Perform the following check.

(1) *Assure fuel control is OFF.*

(2) *Service oil tank.*

WARNING

Stay clear of exhaust nozzle for 15 minutes after shutdown and when vapors are seen coming from nozzle. Vapors may be highly explosive.

(3) *Check nozzle segments for cracks, distortion, and missing parts.*

(4) *Complete engine run-up data record. AFTO Form 781N and maintain with active aircraft forms.*

(5) *Reset bellmouth pitot heater, oxygen gage, ramp control, and AOA probe heater circuit breakers.*

2-46. CHECKOUT PROCEDURES.

2-47. Checkout procedures are provided for use during established inspection periods or for performing troubleshooting. Items to be checked and scheduled frequencies for these checks are established by applicable inspection requirements manuals. Perform checks in sequence. For each step of a checkout procedure for which a normal indication is given, corrective action for each probable abnormal indication is provided in the remedy column. Correct each discrepancy before proceeding with the next step.

2-48. ENGINE CHECKOUT.

2-49. To accomplish engine checkout, perform paragraphs 2-8 thru 2-21 and 2-40.

2-50. **MAIN IGNITION SYSTEM CHECKOUT (Engine Operating).** This procedure provides a check that should be performed whenever a problem is experienced with the main ignition system, or as directed by TO 1F—4C—6. This procedure is to be accomplished on both right and left engines.

Procedure	Normal Indication	Remedy for Abnormal Indication
a. Pull number 1 ignition circuit breaker.		
b. Perform engine start (pneumatic mode) refer to paragraphs 2—21 through 2—21f.		
c. When EGT. rise is noted, release ignition button, move throttle to cut—off.	EGT. rise within 15 seconds after advancing throttle.	Refer to paragraph 2—92.
d. Reset number 1 ignition circuit breaker.		
e. Pull number 2 ignition circuit breaker.		
f. Perform engine start (pneumatic mode) refer to paragraphs 2—21 through 2—21f.		
g. When EGT. rise is noted, release ignition button, move throttle to cut—off.	EGT. rise within 15 seconds after advancing throttle.	Refer to paragraph 2—92.
h. Reset number 2 ignition circuit breaker.		

2-51. AFTERBURNER IGNITION SYSTEM CHECKOUT.

Tools and Equipment.

Power source, external electrical
Pressurizer, afterburner manifold, 1C3568G1

Materials.

Lockwire, MS20995NC32

Procedure	Normal Indication	Remedy for Abnormal Indication
a. Open door 82L or assure safety strut is installed on 81R..		
b. Disconnect afterburner ignition switch signal line at forward tee fitting under afterburner fuel filter.		
c. Connect pressurizer to signal line.		
d. Apply electrical power.		
e. Slowly increase fuel pressure to 80 psi.	Switch actuates at 60 to 80 psi and afterburner igniter fires about 4 times per second.	Refer to para 2-93.
f. Increase pressure to 400 psi.	Igniter continues to fire at same rate.	Refer to para 2-93.
g. Reduce fuel pressure to zero.	Igniter plug stops firing.	Replace afterburner ignition switch.
h. Disconnect electrical power.		
i. Remove pressurizer.		
j. *Reconnect signal line to tee fitting and lockwire. Perform leak check during afterburner run.*		
k. *Close door 82L or remove safety strut from 81R.*		

2-52. CHECKOUT FOLLOWING CARTRIDGE MISFIRE.

Tools and Equipment.

Multimeter
Power source, external electrical

Manpower Requirements.

Two men required

Procedure	Normal Indication	Remedy for Abnormal Indication
WARNING To prevent injury to personnel, make sure safety struts are installed on door 81L and R actuators.		
a. Open doors 140 and 78 or doors 81R and 80. Ensure safety strut is installed on door 81R.		

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
b. Remove starter breech cap.		
c. Actuate applicable engine master switch.		
d. Actuate start selector switch and check for 28Vdc at pin A of starter.	28Vdc available	See fig 3–1.
e. Check continuity between pin B of starter and ground.	Continuity exists	See fig 3–1.
f. Check continuity of breech cap wiring from pin A to inside of cap and pin B to inside of cap.	Continuity exists	Replace starter. Refer to para 3–58.
g. Remove external electrical power.		
WARNING Never attempt to load a cartridge with any electrical power applied, or with engines operating. A malfunction could result in cartridge ignition during the installation process.		
h. Install new cartridge and reattempt start.		
i. *Close doors 140 and 78 or remove safety strut and close doors 81R and 80.*		

2-52A. **AIRFRAME POWER PLANT CONTROL SYSTEM WEAR CHECK.** The airframe power plant control system wear check is a procedure for determining the amount of wear in the control system. This includes the throttle box and torque shaft assembly, including both universal joints, spline shafts, cable to wheel mesh, and cable to conduit relation. This check can be performed without disturbing system rigging.

Tools and Equipment.

Wrench, torque, 0 to 100 inch-pounds (dial type)
Adapter, 1C2754–3G1
Check kit, gearbox wear, throttle control
Safety strut, auxiliary air door
Fuel pressure source, torque booster

Manpower Requirements.

Three men required.

Procedure	Normal Indication	Remedy for Abnormal Indication
WARNING To prevent personnel injury ensure safety struts are installed on door 81 L or R actuators.		
a. Install safety struts on door 81 L or R actuators.		
b. Open doors 82 and 83 L or R.		
c. Connect pressurizing unit to torque booster. See fig 4–18.		

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
d. Visually inspect the following for wear, see view F, figure 2—17A:		
(1) Torque booster input lever bearing.	No visual evidence of wear.	Replace torque booster.
(2) Crossover shaft arm bearing.	No visual evidence of wear.	Replace arm.
(3) Clevis link holes.	No visual evidence of wear.	Replace clevis link.
e. Position throttle to IDLE and install vernier scale protractor MDE323797, on outboard end of main fuel control crossover shaft. See fig 2—17B.		
f. Install fixed scale assembly, MDE323800, to airframe on the bottom of drop out link.		
g. Manually hold throttle against IDLE stop.		
h. Adjust fixed scale assembly to align with peripheral lines located 1/4 inch from outer edge on vernier scale protractor. Align zero radial lines on fixed scale assembly and vernier scale protractor. Use knurled knobs on the fixed scale assembly to make these alignments.		
i. Attach torque wrench and adapter, 1C2754—3G1, to torque booster input shaft. See view E, fig 2—17A.		
j. Apply 30 inch—pounds torque in counterclockwise direction.		
k. Record protractor reading in degrees and minutes.		
l. While holding forward cockpit throttle lever back against idle stop, apply 30 inch—pounds torque in clockwise direction.		
m. Record protractor reading in degrees and minutes.		
n. Add readings obtained in steps k and m.	Total deflection does not exceed 6 degrees.	1. Perform Engine Control Box Wear Check. Refer to para 2—56. 2. Remove 9L door and inspect forward rod end bearing for wear.

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
		3. Check forward cockpit throttle lever bearing for evidence of wear by observing throttle lever when 10 pound force is applied to aft cockpit throttle lever (forward cockpit lever against IDLE or MIL STOP).
		4. Remove engine control box and measure outside diameter of helix wire several places within 12 inches of aft end of teleflex cable. Replace or reverse cables which measure less than 0.184 inch.
		5. Total deflection of 7 1/2 degrees is permissible providing all the above check satisfactorily.
o. Remove protractor and scale assembly.		
p. If system is being rigged, omit following steps and proceed to para 4-115.		
q. Disconnect fuel pressure source torque booster. Refer to fig 4-18.		
r. Connect torque booster supply and return hoses and secure with lockwire.		
s. Start engine and check for leaks. Refer to TO 1F-4C-2-8CL-1.		
t. *Close doors 82 and 83 L or R.*		

2-53. AIRFRAME POWER PLANT CONTROL SYSTEM RIGGING CHECK – ENGINES OFF. This procedure provides a check that should be performed whenever a problem is experienced with the control system or as directed by T O 1F–4C–6. Do not attempt to adjust the idle or military RPM with the main fuel control adjustment screws without having first performed a rigging check to assure the airframe power plant control system is properly rigged.

Tools and Equipment.

Safety strut, auxiliary air door
Fuel pressure source, torque booster
Pin, rig

Materials.

Lockwire, MS20995NC32

Manpower Requirements.

Three men required.

Procedure	Normal Indication	Remedy for Abnormal Indication
1. PREPARATION.		

WARNING

To prevent personnel injury ensure safety strut is installed on 81 L or R door actuators and cartridges are removed from starters.

Procedure	Normal Indication	Remedy for Abnormal Indication
a. Install safety strut on 81 L or R auxiliary air door actuators. See fig 2—17A, view A.		
b. Open doors 82 L or R.		
2. RIGGING CHECK.		
a. If main fuel control has vernier installed: See fig 2—17A, view C.		
(1) Position main fuel control to IDLE and install rig pin in main fuel control. See fig 2—17A, view D.		

CAUTION

When using main fuel control vernier for throttle rigging, always view vernier from approximately same eye level. Establish viewing angle through centerline of shaft to obtain consistent and accurate reading.

Procedure	Normal Indication	Remedy for Abnormal Indication
(2) Ensure vernier match marks are aligned.		
(3) Remove rig pin from main fuel control and position main fuel control to OFF.		
b. Perform power plant control system wear check. Refer to paragraph 2—52A. Do not disconnect pressurizing unit.		
c. With ENGINE MASTER switches OFF move forward cockpit throttle lever slowly to above IDLE and then back to IDLE stop. Pump pressurizing unit handle while throttle lever is being moved to keep torque booster pressurized.		

CAUTION

When using main fuel control vernier for throttle rigging, always view vernier from approximately same eye level to obtain a consistent and accurate reading due to vernier reference marks being on different levels (parallax).

Procedure	Normal Indication	Remedy for Abnormal Indication
d. Hold throttle lever back against IDLE stop.	Vernier reference marks must be aligned or main fuel control (MFC) cam notch must be aligned with rig pin port.	Adjust telescopic unit outer slider per step 4 of wet rig procedure. If outer slider adjustment in excess of 1/2 turn is required, rerig system. Refer to para 4—115.

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
NOTE It is imperative that vernier reference mark or cam notch alignment be precise so that all engine operating parameters can be met satisfactorily. Use main fuel control vernier for rigging purposes.		
e. With torque booster pressurized, position cockpit throttle lever to MIL. Ensure cockpit throttle lever is against military stop.	Vernier reference mark must indicate approximately 1/16 to 3/32 inch below MIL or lower half (incline) of cam notch must be aligned with rig pin port. (The lower half of cam notch is first to come into view when advancing to military.)	Perform military stop plate adjustment portion of wet rigging procedure.
f. Position cockpit throttle lever to MAX AB (full forward).	Forward and aft cockpit throttle levers must have cushion.	Rerig airframe power plant control system, refer to para 4—115.
g. Position cockpit throttle lever to OFF.	Vernier reference marks must be aligned or MFC cam notch must be aligned with rig pin port.	File throttle quadrant stop plate per wet rigging procedure. Refer to section IV.
h. Position both throttle levers to MAX A/B. Check throttle stagger and return levers to OFF.	Throttle stagger does not exceed 1/4 inch.	Rerig airframe power plant control system, refer to para 4—115.
i. Disconnect pressurizing unit.		
j. *Connect torque booster supply and return hoses and secure with lockwire.*		
k. Perform airframe power plant control system rigging check — engines operating. Refer to para 2—54.		

2-54. AIRFRAME POWER PLANT CONTROL SYSTEM RIGGING CHECK — ENGINES OPERATING. This procedure provides a check that should be performed whenever a problem is experienced with the system or as directed by T O 1F—4C—6. Do not attempt to adjust IDLE or MIL RPM with the main fuel control adjustment screws without having first performed a rigging check to assure the airframe power plant control system is properly rigged.

Tools and Equipment.

Guards, air duct
Wrench, torque, 0 to 100 inch-pounds (dial type)
Adapter, 1C2754—3G1
Communication equipment, ground
Holdback assembly
Power source, external electrical
Safety strut, auxiliary air door
Spring scale, 0 to 10 pounds

Materials.

Pin, cotter, MS24665-134

Manpower Requirements.

Three men required.

Procedure	Normal Indication	Remedy for Abnormal Indication
a. Ensure following: See fig 2—17A, view G.		
(1) Rod end attaching bolts in door 9L are tight and cotter pins are installed.		
(2) Threads visible in rod end inspection hole and rod end jamnuts tight.		
(3) Cable visible in cable inspection holes and cable lockplugs tight.		

WARNING

To prevent loss of throttle control, do not install 3/16 inch bolt in torque shafts that have 1/4 inch hole.

Procedure	Normal Indication	Remedy for Abnormal Indication
(4) Control box torque shaft connecting bolts tight and cotter pins installed.		

CAUTION

To prevent excessive wear to torque shaft, washers should be used on torque shaft bolt to ensure nut does not bottom out on bolt shank.

Procedure	Normal Indication	Remedy for Abnormal Indication
(5) Grasp control box torque shaft and main fuel control crossover shaft and check for rotational play between the two shafts. Also, attempt to slide torque shaft off and on main fuel control crossover shaft.	Control box torque shaft must be tight on main fuel control crossover shaft.	1. *Torque connecting bolt.* 2. Ensure splines are good on main fuel control crossover shaft and then replace engine control box.
(6) Ensure torque shaft connecting bolts are engaged in undercut in main fuel control crossover shaft. See fig 2—17A, view H.	Less than 1/8 inch of splines visible between torque shaft and crossover shaft arm on right engine and no splines visible from end of torque shaft on left engine.	Engage bolt shank in crossover shaft undercut. *Torque 3/16 inch bolt 13 to 15 inch-pounds and 1/4 inch bolts 30 to 40 inch-pounds.*
(7) Clevis link bolts tight and cotter pins installed. See fig 2—17A, view J.	Hardware properly installed.	*Torque bolts 13 to 15 inch-pounds.*
(8) Torque booster pressure and return hoses tight and secured with lockwire. See 2-17A, view J.		
b. Inspect both cockpits for foreign objects.		
c. Ensure all control panels are installed and both cockpits are in order.		
d. If maintenance has been performed in door 9L area, inspect for foreign objects.		
e. Disconnect actuators from doors 81 L and R and tie doors back. Ensure safety struts are installed on actuators.		
f. Open and tie back doors 82 L and R.		
g. Open doors 83 L and R.		
h. *Inspect engine bay for foreign objects.*		

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
i. Install engine inlet air duct guards.		
j. Install holdback assembly. Refer to fig 2—3.		
k. Record starting fuel flow (initial rise in fuel flow) during engine start, step l, for use in step q.		
l. Start both engines, refer to para 2—8, and stabilize at IDLE. Check torque booster pressure and return hoses for leaks. See fig 2—17A, view J.	No visible leakage.	Replace defective hose or torque booster.
m. Engine Idle Check (Both Engines).		
(1) Place forward cockpit throttle levers back against IDLE stop.		

CAUTION

Do not attempt to remove throttle cable twist with engines operating. Rapid throttle movement causes excessive thermal cycling and turbine deterioration.

NOTE

It is imperative that vernier reference mark or cam notch alignment be precise in order that all engine operating parameters can be met satisfactorily.

Procedure	Normal Indication	Remedy for Abnormal Indication
(2) Check MFC vernier reference marks for alignment or MFC IDLE notch for alignment with rig pin port.	MFC vernier reference marks are aligned or IDLE notch is aligned in rig pin port.	Check throttle rigging, if outer slider adjustment is required, rerig system. Perform Airframe Power Plant Control System Rigging, refer to para 4-115.
(3) With throttle lever at IDLE, note fuel flow and engine RPM.	Fuel flow decrease less than 100 pph and RPM decrease less than 1 percent from values obtained in step 3.	Repeat step m, items (1) and (2) and repeat system wear check. Refer to para 2—52A. Ensure idle adjustment screw is contacting main fuel control cam.
(4) Attach torque wrench and adapter to outboard end of MFC crossover shaft and apply 30 inch—pounds torque in direction of cutoff and hold for 30 seconds. See fig 2—17A, view K.		
(5) Remove torque wrench and advance throttle to approximately 80 percent and return to IDLE.		

NOTE

Ensure IDLE reference marks or cam notch is aligned prior to making RPM adjustment.

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
(6) Check engine IDLE RPM.	IDLE RPM 64 to 66 percent.	Adjust accordingly using main fuel control adjustment screws. Refer to para 4—133.
(7) Check aft cockpit levers for alignment.	Lever misalignment does not exceed 1/4 inch.	Adjust aft cockpit throttle levers. Refer to para 4—75.
NOTE Accomplish MIL check on one engine at a time.		
n. MIL Check.		
(1) Position throttle lever to MIL. See fig 2—17A, view L.	Cam notch on low side of cam, 1/2 hole, or vernier reference mark 1/16 to 3/32 inch below MIL.	Adjust MIL stop as required. Refer to para 4—120.
CAUTION To prevent overheating, observe 30 second time limitations with door 83 open.		
(2) With throttle lever positioned at MIL, check for indication of AB light from both front and rear cockpits. Apply 7 to 10 pounds force forward to aft cockpit throttle lever.	Afterburner does not light.	Repeat step (1) above and then check for loose rod end bearing in door 9L.
(3) Check engine MIL RPM.	RPM within limits.	Adjust RPM. Refer to para 4—134.
NOTE Accomplish MAX A/B check on one engine at a time.		
o. MAX A/B Check.		
(1) Position forward cockpit throttle lever to MAX.	Forward and aft cockpit throttle levers must have cushion (spring back).	Rerig airframe power plant control system. Refer to para 4—115.
(2) Check engine RPM.	RPM same as obtained during MIL check.	Repeat MIL check (step n).
p. Retard throttle to MIL.		
q. Snap decel to IDLE.	Fuel flow does not drop below value obtained in step k.	Repeat idle check (step m) and then perform system wear check.
r. Allow engine to stabilize at IDLE and then apply 7 to 10 pounds pressure to aft cockpit throttle lever in direction of off.	Fuel flow and RPM do not decrease.	Repeat idle check (step m).
s. Cool engines at IDLE for 3 minutes.		
t. Position throttle levers to OFF and check for positive fuel shutoff.	Engines shutdown.	Rerig airframe power plant control system. Refer to para 4—115.
u. *Install door 9L.*		
v. *Close doors 82 and 83L and R.*		

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
w. Connect actuator to door 81L or R.		
x. Remove holdback assembly.		
y. *Quality Assurance Summary.*		
(1) *Rod end jamnuts tightened.*		
(2) *Cable lock plugs tightened.*		
(3) *Threads visible in all rod end inspection holes.*		
(4) *Cable visible in telescopic unit cable inspection hole.*		
(5) *Ensure system is secured.*		

2–55. **AFT COCKPIT IDLE THROTTLE CHECK (ENGINE OPERATING).** A check to be performed to verify the aft cockpit throttle levers will not inadvertently shut down the engine when retarding the aft cockpit throttle levers to IDLE.

Tools and Equipment.

Scale, spring, 0 to 10 pounds

Procedure	Normal Indication	Remedy for Abnormal Indication
a. Start engine and stabilize at IDLE, refer to paragraphs 2–8 thru 2–21.		
b. Retard aft cockpit throttle lever until forward cockpit throttle lever contacts quadrant stop. Note fuel flow and engine RPM.		
c. Apply 7 to 10 pounds load in aft direction to center of throttle lever grip.		
d. Maintain 7 to 10 pound load for 30 seconds.	Fuel flow and RPM should not decrease from value noted in step b.	Perform an Airframe Power Plant Control System rigging check, refer to paragraph 2–53 and a Power Plant Control System Wear Check, refer to paragraph 2–52A.
e. Shut down engine.		

2–56. **ENGINE CONTROL BOX WEAR CHECK.** A procedure for determining the amount of wear (backlash) on the throttle box and torque shaft assembly, including both universal joints, spline shaft and cable to wheel mesh. This check can be performed on left or right side without disturbing the system rigging.

Tools and Equipment.

Check kit – gearbox wear – throttle control
Wrench, torque, 0–100 inch–pounds
Safety strut, auxiliary air door

Manpower Requirements.

Two men required.

Procedure	Normal Indication	Remedy for Abnormal Indication
1. PREPARATION. See fig 2—17B.		

WARNING

To prevent personnel injury assure safety struts are installed on door 81 L or R actuators.

Procedure	Normal Indication	Remedy for Abnormal Indication
a. Install safety struts on door 81 actuators.		
b. Open doors 82 and 83 L or R.		
c. With forward cockpit throttle lever positioned at OFF, remove overtravel tube from aft side of engine control box located in engine bay.		
d. Ensure ENGINE MASTER switches are OFF. Position forward cockpit throttle lever approximately midway between IDLE and MIL so fuel control crossover shaft arm is vertical.		
e. Slide cable clamp 32D390044—1 over teleflex cable that protrudes from aft end of engine control box. Thread cable clamp into control box finger tight. Rotate crossover shaft until end of teleflex cable is flush with end of cable stop. Tighten lock plug finger tight plus a quarter turn.		
f. Apply a moderate load to forward cockpit throttle lever in the aft direction, to place teleflex cable in tension. Advance the friction lever to retain the throttle lever in this position.		
g. Place 32D390022 protector over throttle quadrant, if available.		
h. Disconnect clevis link from crossover shaft arm, allow it to swing free. See view B, fig 2—17A.		

NOTE

Check crossover shaft to control box torque shaft connecting bolt for proper torque.

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
i. Grasp control box torque shaft and MFC crossover shaft and check for rotational free play. Also, attempt to slide torque shaft off and on MFC crossover shaft.	Torque shaft tight on MFC crossover shaft, no movement permitted.	1. Torque 3/16 inch bolts 13 to 15 inch–pounds and 1/4 inch bolts 30 to 40 inch–pounds. Washers may be used under bolt head as necessary to prevent nut from bottoming against bolt shank. 2. If movement is still present, inspect MFC crossover shaft and control box splines for wear. Replace control box or crossover shaft as necessary.
j. Install vernier scale protractor, MDE323797, on outboard end of main fuel control crossover shaft and tighten retaining bolt.		
k. Install fixed scale assembly, MDE323800, to airframe on the bottom of dropout link.		
2. WEAR CHECK.		
a. Position moment arm to forward side of protractor assembly and attach 2 pound removable weight, 32D390016. This applies a 5 inch–pound torque to control box.		
b. Adjust fixed scale assembly to align with peripheral lines located 1/4 inch from outer edge on vernier scale protractor. Align zero radial lines on fixed scale assembly and vernier scale protractor. Use knurled knobs on the fixed scale assembly to make these alignments.		
c. Position the moment arm to aft side of protractor with 2 pound removable weight installed. This applies a 5 inch–pound torque to control box.		
d. Record reading in degrees and minutes as indicated on protractor assembly.	Total deflectin shall not exceed 2 degrees.	Replace engine control box. Refer to para 4–62.
e. Loosen nut on cable clamp locking plug. Remove cable clamp from engine control box.		
f. With 2 pound weight on moment arm, align zero radial lines on fixed scale assembly and vernier scale protractor.		
g. Position moment arm to forward side of protractor assembly and install 2 pound weight.		
h. Record reading in degrees and minutes as indicated on protractor assembly.	Total deflection shall not exceed 3 degrees.	1. Remove engine control box and measure outside diameter of helix wire several places within 12 inches of aft end of teleflex cable. Replace or reverse cables which measure less than 0.184 inch. 2. Replace engine control box. Refer to para 4–62.

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
i. Remove weight from the moment arm.		
j. Remove fixed scale assembly from rear dropout link.		
k. Remove vernier scale protractor from outboard end of main fuel control crossover shaft.		
l. Connect clevis link to crossover shaft arm, install bolt and nut, torque nut 13 to 15 inch–pounds and install cotter pin.		
m. If installed, remove protector from throttle quadrant. Position throttle friction lever aft and return throttles to OFF position.		
n. Install overtravel tube on engine control box. Torque 40 to 60 inch–pounds and lockwire.		
o. Close doors 82 L or R and 83 L or R.		

2-57. **AIRFRAME POWER PLANT CONTROL SYSTEM FRICTION CHECK.** A procedure to be performed prior to rigging the airframe power plant control system or whenever the system is suspected of having excessive friction. The check may be performed with or without the engine installed.

Tools and Equipment.

Wrench, torque, 0 to 100 inch–pounds
Scale, spring, 0 to 10 pounds
Safety strut, auxiliary air door

Materials.

Pin, cotter, MS24665–134

Procedure	Normal Indication	Remedy for Abnormal Indication
1. PREPARATION.		

WARNING

To prevent personnel injury assure safety strut is installed on 81 L or R door actuators.

Procedure	Normal Indication	Remedy for Abnormal Indication
a. Install safety strut on door 81 L or R actuator.		
b. If engine is installed and airframe power plant control system is rigged to engine, disconnect torque boost clevis link from arm of main fuel control (MFC) crossover shaft. See view B, figure 2–17A.		
c. If engine is not installed, support torque shaft in horizontal position.		

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
d. Move forward cockpit throttle quadrant friction lever full aft.		
2. FRICTION CHECK.		

NOTE

Center engine control panel must be installed when performing this check.

Some throttle levers have individual friction adjustment screws down at quadrant shaft. Adjustment screws should be utilized to obtain 0.5 pound maximum differential between left and right systems.

Procedure	Normal Indication	Remedy for Abnormal Indication
a. Attach scale to center of hand grip on forward cockpit throttle lever and check amount of force required to move throttle lever between IDLE and MIL.	Force to move throttle lever shall not exceed 5 pounds.	Remove center engine control panel and back off throttle lever friction adjust screw, if applicable, for system with highest friction or both if readings are above value given. Reinstall center engine control panel. Repeat step a. If readings are still excessive refer to paragraph 2–115.
b. If applicable, remove center engine control and tighten throttle lever friction adjust screw on system with lowest friction until difference between the left and right system is 0.5 pound.	System friction should not exceed 5 pounds with an 0.5 pound differential between left and right systems.	Refer to paragraph 2–115.
c. Connect torque boost clevis link to arm of MFC crossover shaft.		
d. Torque bolt attaching clevis link to arm on crossover shaft to 13 to 15 inch–pounds. Install cotter pin.		

2-58. ENGINE CONTROL BOX UNIVERSAL JOINT FRICTION CHECK. A procedure to be performed when excessive friction is present in throttle system.

Tools and Equipment.

Scale, spring, 0 to 10 pounds
Safety strut, auxiliary air door
Wrench, torque, 0 to 100 inch–pounds

Materials.

Pin, cotter, MS24665–134

Manpower Requirements.

Two men required.

Procedure	Normal Indication	Remedy for Abnormal Indication
1. PREPARATION.		
WARNING To prevent personnel injury, assure safety strut is installed on 81 L or R door actuators.		
a. Install safety struts on 81 L or R door actuators.		
b. Remove spline shaft bolt and disconnect engine control box torque shaft from main fuel control (MFC) crossover shaft inside door 81 L or R.		
c. Collapse torque shaft to its shortest possible length.		
2. FRICTION CHECK.		
a. Check inboard universal joint as follows:		
(1) Attach scale to end of torque shaft in area of lockwired bolt.		

Procedure	Normal Indication	Remedy for Abnormal Indication
2. FRICTION CHECK. (Cont.)		

NOTE

Application of these forces as described is equivalent to 9 inch -pounds torque on universal joints.

Procedure	Normal Indication	Remedy for Abnormal Indication
(2) Apply force at a 90° angle to shaft until shaft pivots on one universal joint pin.	Force should be one-third pound when applied in downward direction.	Remove and replace engine control box. refer to section IV.
(3) Rotate shaft 90° and apply force to pivot shaft on other end of universal joint pin.	Force should be one-third pound when applied in downward direction.	Remove and replace engine control box. refer to section IV.
b. Check outboard universal joint as follows:		
(1) Hold shaft in horizontal position.		
(2) Attach scale in end fork of shaft at a 90° angle to shaft.		

NOTE

Application of forces as described results in 9 inch-pounds torque on universal joints.

Procedure	Normal Indication	Remedy for Abnormal Indication
(3) Apply force to pivot end of fork on one pin of outboard universal joint.		
(4) Rotate scale 90° and apply force to pivot and fork on other universal joint pin.	Force required to pivot end fork on either pin of outboard universal joint should be 7 3/4 pounds.	Remove and replace engine control box. refer to section IV.
c. Connect torque shaft to MFC crossover shaft as follows:		
(1) Position forward cockpit throttle lever at IDLE.		
(2) Position MFC at IDLE as indicated by notch in rig pin port or vernier reference marks.		
(3) *Spline the torque shaft to MFC crossover shaft. Install bolt and torque 3/16 inch bolts 13 to 15 inch—pounds or 1/4 inch bolts 30 to 40 inch—pounds and install cotter pin.*		
d. Perform an airframe power plant control system rigging check. refer to paragraph 2-53.		

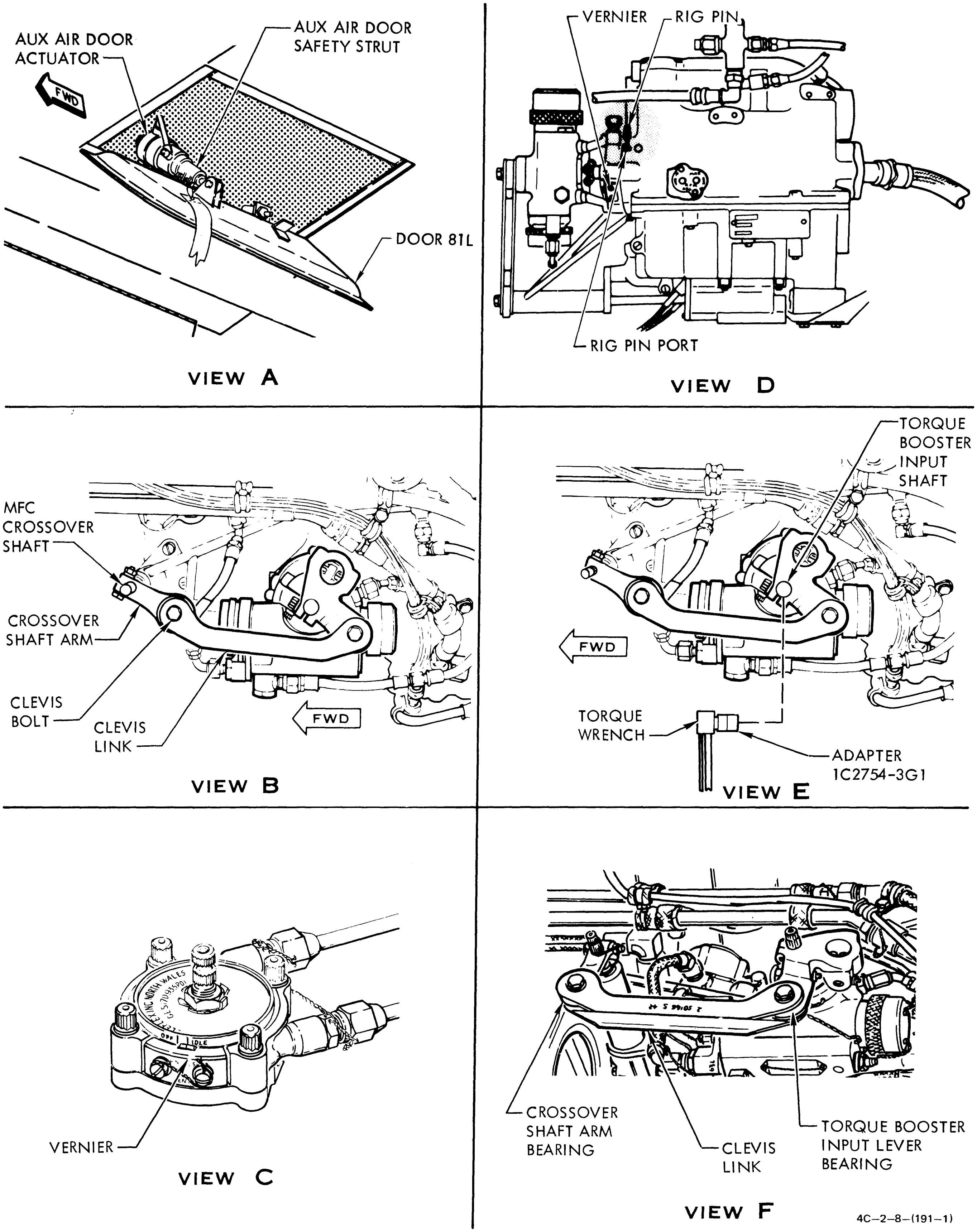


Figure 2-17A. Airframe Power Plant Control System Checkout (Sheet 1 of 3)

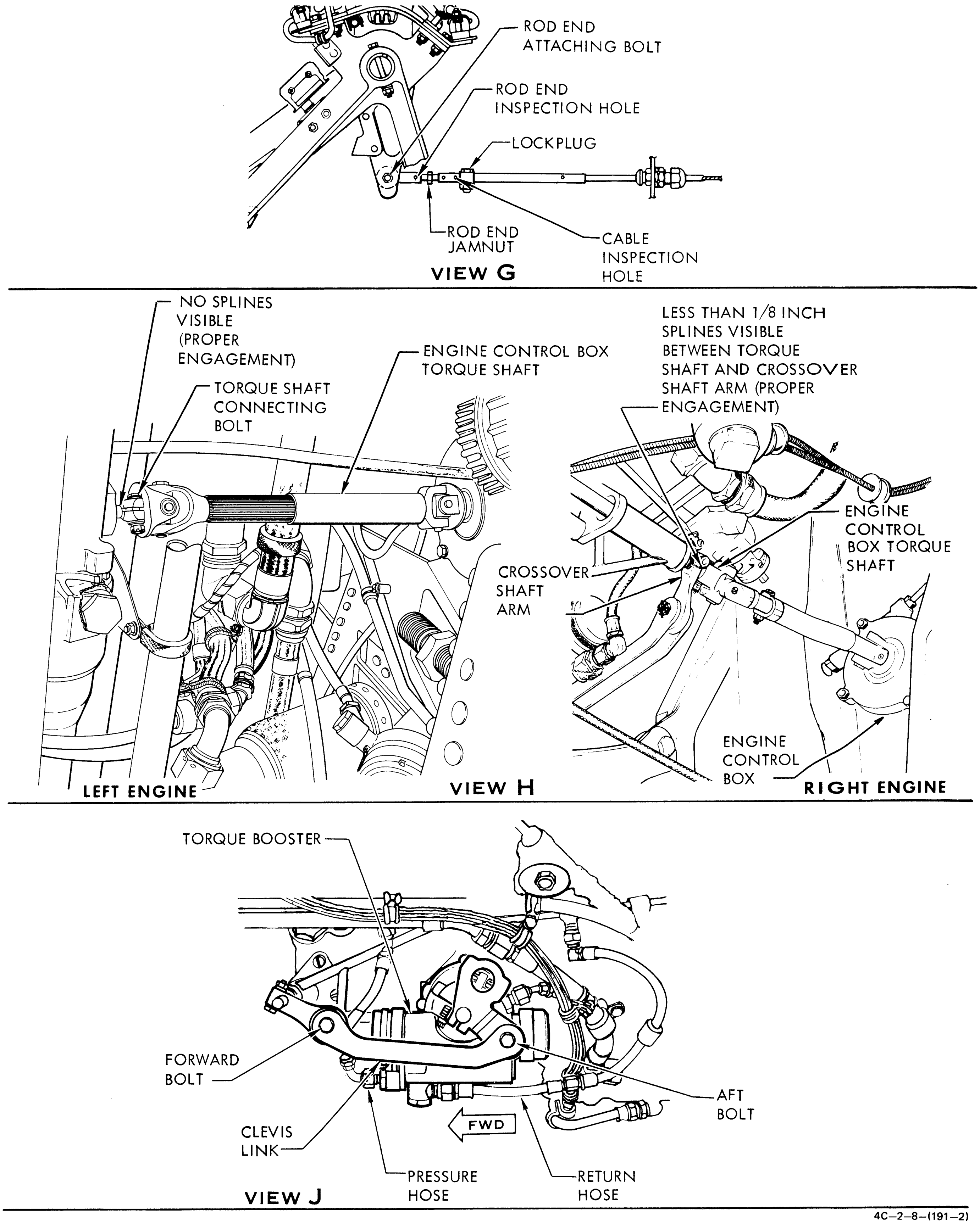
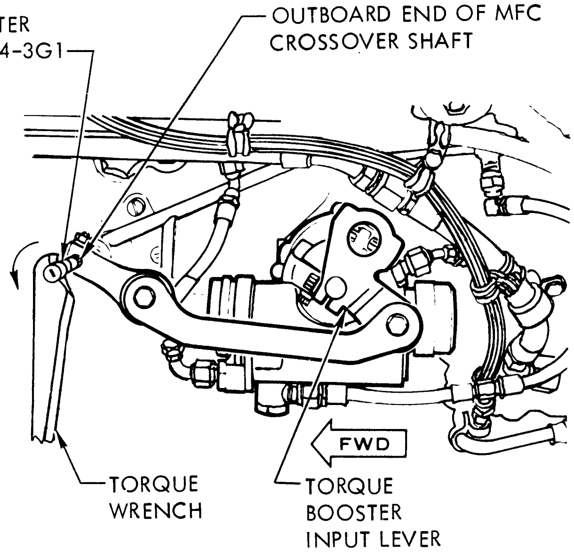
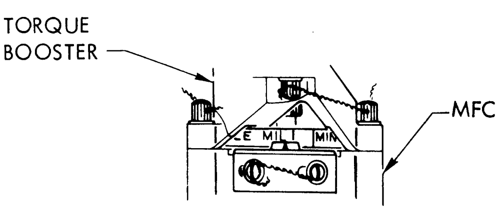


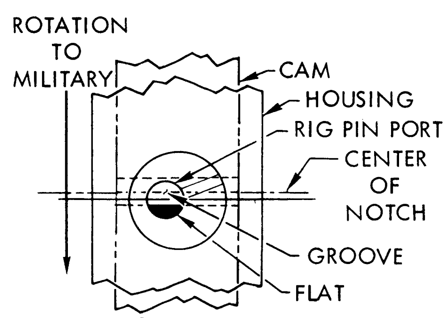
Figure 2-17A. Airframe Power Plant Control System Checkout (Sheet 2 of 3)



VIEW K



VERNIER REFERENCE

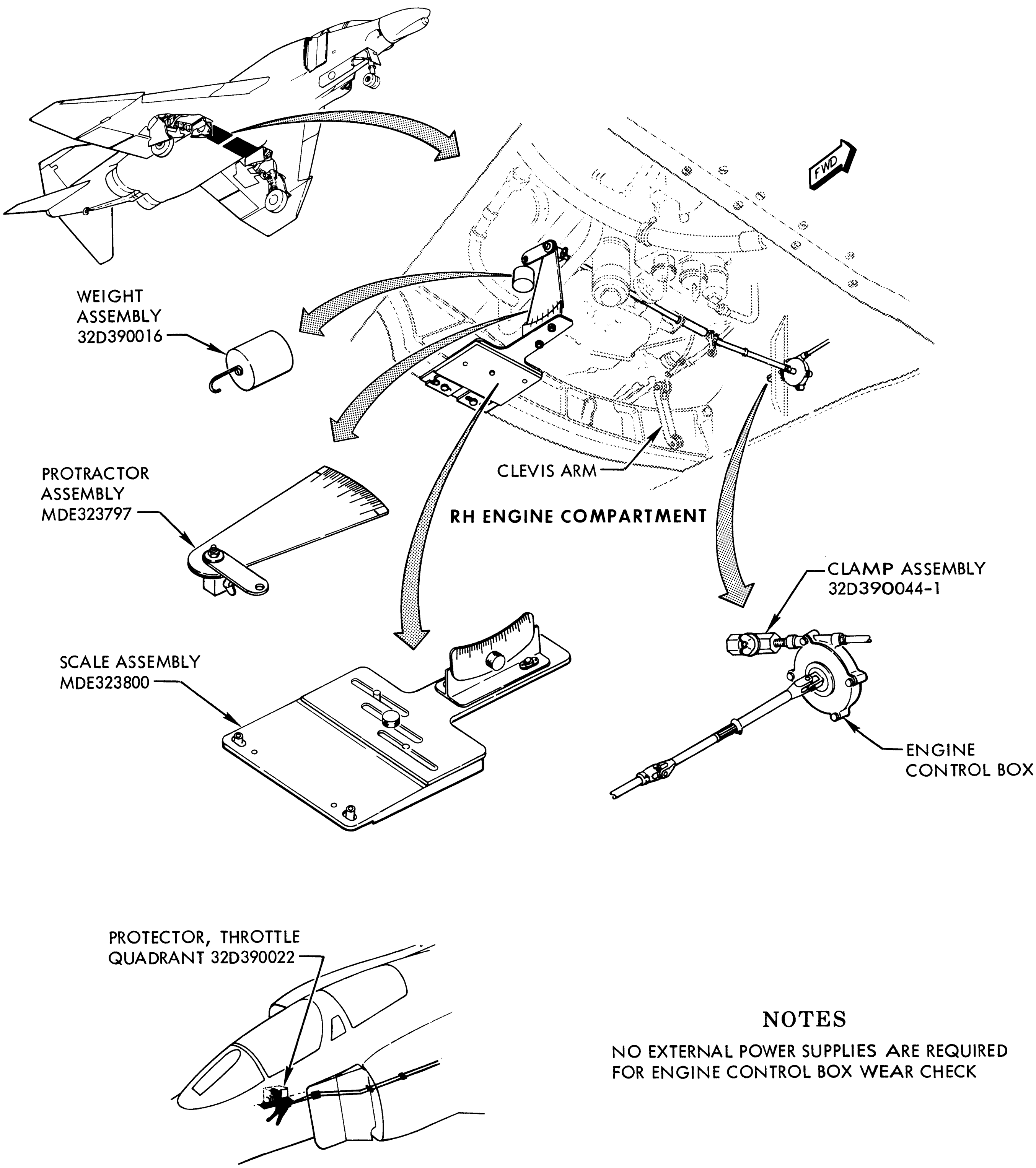


MFC CAM NOTCH

VIEW L

4C-2-8-(191-3)

Figure 2-17A. Airframe Power Plant Control System Checkout (Sheet 3 of 3)



NOTES

NO EXTERNAL POWER SUPPLIES ARE REQUIRED FOR ENGINE CONTROL BOX WEAR CHECK

4C–2–8–(145)

Figure 2-17B. Engine Control Box Wear Check

2-59. **FINGER LIFT MECHANISM CHECK.** A procedure for checking spring return action of the finger lift preventing an inadvertent engine shut down.

Tools and Equipment.

Scale, spring, 0 to 10 pounds

Scale, spring, 0 to 20 pounds

Procedure	Normal Indication	Remedy for Abnormal Indication
NOTE This check is good for left or right throttle lever.		
a. Place forward cockpit throttle lever at IDLE but not contacting the stop cam.		
b. Using scale check force required to raise the finger lift.	Force should be 5 to 7 pounds.	Correct area of binding.
c. Slowly release finger lift.	Finger lift should return to down position.	Correct area of binding.
d. Pull aft on throttle lever applying a force of 10 to 15 pounds.	Throttle lever should not pass idle stop cam.	Ensure finger lift returns to full down position. Correct area of binding. If throttle lever passes idle stop cam, ensure finger lift return spring is good and then replace stop cam.
e. Repeat finger lift check several times to assure functional reliability.		
f. Return throttle lever to OFF position.		

2-60. **FORWARD COCKPIT THROTTLE LEVER SHIFT BREAKOUT FORCE CHECK.** A check to perform that assures breakout force of the throttle lever is within limits allowing the levers to be shifted at the detents.

Tools and Equipment.

Scale, spring, 0 to 40 pounds

Procedure	Normal Indication	Remedy for Abnormal Indication
NOTE Lubricate throttle levers before performing check.		
a. Assure ENGINE MASTER switch is OFF.		

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
b. Advance forward cockpit throttle lever to MIL position.		

NOTE

This check is good for both left and right throttle levers.

Procedure	Normal Indication	Remedy for Abnormal Indication
c. Press scale to center of crosshead screw just below speed brake switch on handgrip. Measure force required to shift lever outboard.	Force required to shift throttle lever must be within range of 8 to 12 pounds.	Adjust shift breakout force, refer to section IV.
d. Return forward cockpit throttle lever to OFF position.		

2-61. **AFT COCKPIT THROTTLE LEVER LOAD LIMITER CHECK.** A check to be performed that ensures the aft cockpit throttles will become disengaged from system before enough force is applied to damage throttle system. Also to enable pilot to maintain control of engine power.

Tools and Equipment.

Scale, push pull, 50 to 100 pounds

Procedure	Normal Indication	Remedy for Abnormal Indication
a. Assure ENGINE MASTER switches are OFF and place forward cockpit throttle lever in IDLE position.		
b. Attach scale to hand grip on aft cockpit throttle lever and apply a load in aft direction to break lever free.	Load required to break lever free must be within range of 55 to 100 pounds.	1. If force required was below minimum allowable, remove aft cockpit throttle quadrant and shim load limiter spring or install a new spring. 2. If force required was above maximum allowable, remove aft cockpit throttle quadrant and inspect plunger and bellcrank for nicks or burrs. Install new plunger and/or bellcrank.
c. Place forward cockpit throttle lever to MIL against military stop.		
d. Reset aft cockpit throttle lever by applying a load in forward direction.		

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
e. Attach scale to hand grip on aft cockpit throttle lever and apply a load in forward direction to break lever free.	Load required to break lever free must be within range of 55 to 100 pounds.	1. If force required was below minimum allowable, remove aft cockpit throttle quadrant and shim the load limiter spring or install a new spring. 2. If force required was above maximum allowable, remove aft cockpit throttle quadrant and inspect the plunger and bellcrank for nicks or burrs. Install new plunger and/or bellcrank.
f. Place forward cockpit throttle lever in IDLE position against idle stop.		
g. Reset aft cockpit throttle lever by applying a load in aft direction.		
h. Return forward cockpit throttle lever to OFF.		

2-62. **THROTTLE INPUT LINKAGE RIGGING CHECK.** A check to perform when the engine throttle input linkage is suspected of improper operation or the engine is not operating as prescribed.

Tools and Equipment.

Pin, rig

Materials.

Lockwire, MS20995NC32

Procedure	Normal Indication	Remedy for Abnormal Indication
a. Set linkage at rig position as follows:		
(1) Install throttle shaft wrench on main fuel control throttle input shaft or torque booster input shaft.		
(2) Position main fuel control throttle input shaft against OFF mechanical stop.		
b. Assure afterburner fuel control and nozzle area control throttle input shafts are at rig position as follows:		
(1) Remove input rigging port plug from nozzle area control.		
(2) Insert rig pins through rigging ports and into input shaft rigging slots of controls.	Pins should enter shaft rigging slots without binding.	Rig throttle input linkage. Refer to section IV.

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
c. Remove rig pins.		
d. Install plug in nozzle area control input rigging port.		
e. *Secure plug with lockwire.*		
f. Perform engine checkout. Refer to paragraphs 2-8 thru 2-21, and 2-40.		

2-63. **VARIABLE VANE FEEDBACK LINKAGE RIGGING CHECK.** A check to be performed when the engine is suspected of not operating within prescribed limits.

Manpower Requirements.

Two men required.

Procedure	Normal Indication	Remedy for Abnormal Indication
NOTE Static rig position varies from engine to engine, only an operational or running null check assures linkage is properly rigged.		
a. Locate vane position indicator at 7 o'clock position in sixth variable vane stage.		
b. Start engine and slowly accelerate to MIL, refer to paragraphs 2-8 thru 2-21.	With engine operating at steady state condition, vanes should be within limits specified in figure 2-19.	If vanes are not within limits, adjust linkage per section IV.
c. Shut down engine.		

2-64. **NOZZLE AREA CONTROL TO NOZZLE PUMP LINKAGE RIGGING CHECK.** A check to be performed to check integrity of the nozzle pump and nozzle area control.

Tools and Equipment.

Pin, rig

Procedure	Normal Indication	Remedy for Abnormal Indication
a. Lock nozzle area control output rod at rig position as follows: (1) Pull rod outward from control. (2) Rotate rod to locate etch mark on rod and align this mark with output rod rigging port. (3) Insert rigging pin into rigging port.		

CAUTION

Do not disturb setscrew. If setscrew does not contact rigging pin or binds so rigging pin cannot be easily rotated with fingers, adjust linkage. Refer to section IV.

Procedure	Normal Indication	Remedy for Abnormal Indication
(4) Push rod into control until rigging pin enters rigging hole in rod.		

CAUTION

When installing bolt connecting nozzle area control output rod to nozzle pump arm, use a washer under head of bolt only. Check for clearance between bolt and nozzle pump casting by moving lever arm through its full travel; if bolt hits pump, add another washer under bolt head. Install and torque locknut, repeat above clearance check.

Procedure	Normal Indication	Remedy for Abnormal Indication
b. Assure nozzle pump input shaft is at rig position by inserting rig pin into pump rigging port.	Set screw on pump control lever should make contact with rigging pin.	Rig nozzle feedback linkage. Refer to section IV.
c. Remove rigging pin from rigging port.		

2-65. **NOZZLE FEEDBACK LINKAGE RIGGING CHECK.** A check to be performed when the nozzles are suspected of malfunctioning.

Tools and Equipment.

Pressurizing unit, nozzle actuator
Set, rigging

Materials.

Lockwire, MS20995NC32

Manpower Requirements.

Two men required.

Procedure	Normal Indication	Remedy for Abnormal Indication
a. Check nozzle area control for proper feedback rigging as follows:		
(1) Remove rig pin port cover plug from nozzle area control.		
(2) Insert rig pin into rigging port of nozzle area control.		
(3) Use pressurizing unit to adjust nozzle until rig pin engages feedback rig wheel. Do not move nozzle after rig pin is engaged.		
(4) Use diameter recorder to take four equally spaced measurements across trailing edge of primary flaps.	Measurements should be 22 5/16 $\pm$ 1/16 inches average diameter.	Rig nozzle feedback linkage. Refer to section IV.
b. Prepare linkage for service as follows:		
(1) Remove rigging pin.		
(2) Install rigging port plug.		
(3) Actuate nozzle flaps open.		
(4)*Disconnect pressurizing unit hoses from engine. Install pressure tap caps.*		
(5) Connect hydraulic pressure relief valve line to T-fitting in nozzle pump supply line.		
(6)*Secure rigging port plug and pressure tap caps with lockwire.*		

2-66. EXHAUST NOZZLE MECHANICAL SCHEDULE CHECKOUT.

Procedure	Normal Indication	Remedy for Abnormal Indication
a. Open door 82L or install safety strut on door 81R.		
b. Disconnect electrical lead from control alternator.		
c. Start engine. Refer to paragraphs 2-8 thru 2-21..		

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
CAUTION With control alternator disconnected from amplifier, temperature limiting system is inoperative. Do not exceed EGT limits or damage to engine will result.		
d. Slowly advance throttle until EGT of 625° ±10°C is reached.	Nozzle starts to close at 66 to 68 percent RPM. Nozzle stops closing at 86 percent RPM. Smooth, steady movement of nozzle indicator.	Refer to paragraph 2–98.
e. Slowly retard throttle to IDLE.	Nozzle starts to open at 86 percent RPM. Nozzle position 7/8 to 3/4 open at 66 to 68 percent RPM.	Refer to paragraph 2–98.
f. Shut down engine.		
g. *Connect electrical lead to control alternator.*		
h. *Close door 82L or remove safety strut from door 81R.*		

2–67. HIGH OIL CONSUMPTION CHECKOUT.

Tools and Equipment.

Oil Servicing Unit

Procedure	Normal Indication	Remedy for Abnormal Indication
WARNING To avoid injury to personnel, safety struts must be installed on door 81L or 81R before servicing oil system.		
a. Service oil system.		
b. Start engine. Refer to paragraphs 2–8 thru 2–21.		
c. Run at IDLE for 2 minutes.		
d. Run at MIL for 15 minutes.		

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
e. Cool engine at IDLE for 3 minutes.		
f. Shut down engine.		
g. Service oil system within 30 minutes.	Oil consumption 1/2 pint max.	Refer to para 13-39.

2-68. VARIABLE VANE ACTUATOR CHECKOUT.

Tools and Equipment.

Tester, inlet guide vane 1C3568G1

Procedure	Normal Indication	Remedy for Abnormal Indication
a. Connect tester to actuator.		
b. Operate tester.	Vanes move smoothly at pressure of 200 psi maximum.	Replace vane actuator, refer to section IX.

2-69. ANTI-ICING SYSTEM CHECKOUT.

Procedure	Normal Indication	Remedy for Abnormal Indication
a. Start engine. Refer to para 2-8 thru 2-21.		
b. Advance throttle to 80 percent RPM and stabilize.		
c. Move ENGINE ANTI-ICING switch to DE -ICE.	L ANTI-ICE ON or R ANTI -ICE ON light comes on. Slight rise in EGT, approximately 10°C.	Refer to para 2-86.
d. Return ENGINE ANTI-ICING switch to NORMAL.	L ANTI-ICE ON or R ANTI -ICE ON light goes out.	Replace anti-icing indicator switch if EGT returns to normal. Refer to T O 2J-J79 -46.
	EGT returns to normal.	Replace anti-icing valve. Refer to T O 2J-J79-46.

2-70. EXHAUST GAS TEMPERATURE INDICATOR CHECKOUT. 63-7598 THRU 64-928.

Procedure	Normal Indication	Remedy for Abnormal Indication
a. Start engines. Refer to para 2-8 thru 2-21.		
b. Pull circuit breakers 81B308 and 81CB309.	EGT indicators continue to operate.	Refer to T O 1F-4C-2-11.
c. *Reset circuit breakers 81CB308 and 81CB309.*		
d. Pull EGT INVERTER circuit breaker 81CB303.	EGT indicators continue to operate.	Refer to para 2-113.
e. *Reset circuit breaker 81CB303.*		
f. Shutdown engines.		

2-71. Deleted.

2-72. Deleted.

2-73. BH112J or JA JETCAL ANALYZER CHECKOUT PROCEDURES.

2-74. BH112J or JA Jetcal Analyzer-Initial Jetcal Operating Procedures. See figure 2-21.

2-75. BH112J or JA Jetcal Analyzer-EGT System Functional Check (Jetcal Check Procedure I). See figure 2-22.

2-76. BH112J or JA Jetcal Analyzer-EGT Indicator Check (Jetcal Check Procedure II). See figure 2-23.

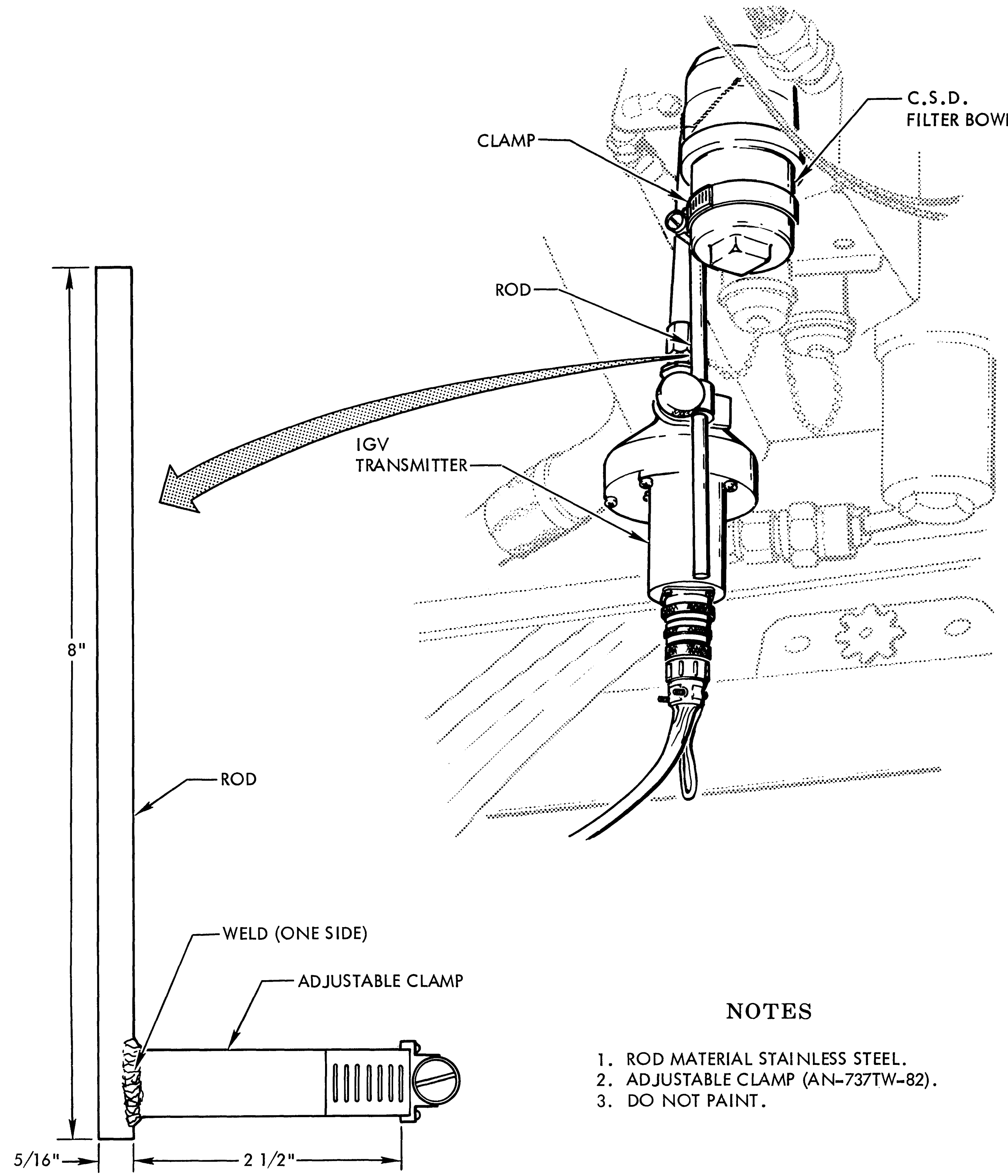
2-77. BH112J or JA Jetcal Analyzer-Tachometer System Check (Jetcal Check Procedure III). See figure 2-24.

2-78. BH112J or JA Jetcal Analyzer-Thermocouple Check. See figure 2-25.

2-79. BH112J or JA Jetcal Analyzer-Fire Detector System Test. See figure 2-26.

2-79A thru 2-79D. Deleted.

2-80. BH112J or JA Jetcal Analyzer-Aft Fuselage Overheat Detector System Test. See figure 2-27.

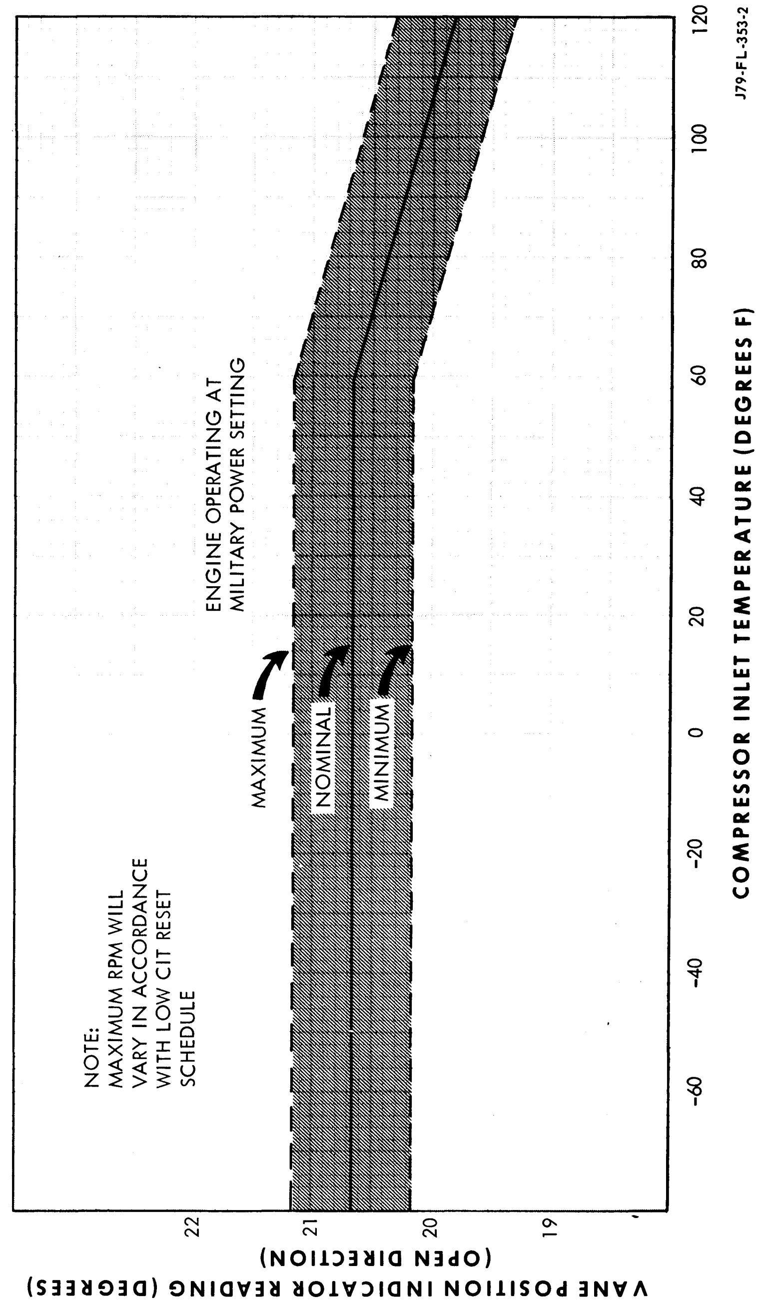


NOTES

1. ROD MATERIAL STAINLESS STEEL.
2. ADJUSTABLE CLAMP (AN-737TW-82).
3. DO NOT PAINT.

4C-2-8-(13)

Figure 2-18. IGV Transmitter Attaching Rod for QEC Engines



4C–2–8–(15)

Figure 2–19. Variable Vane Position vs CIT

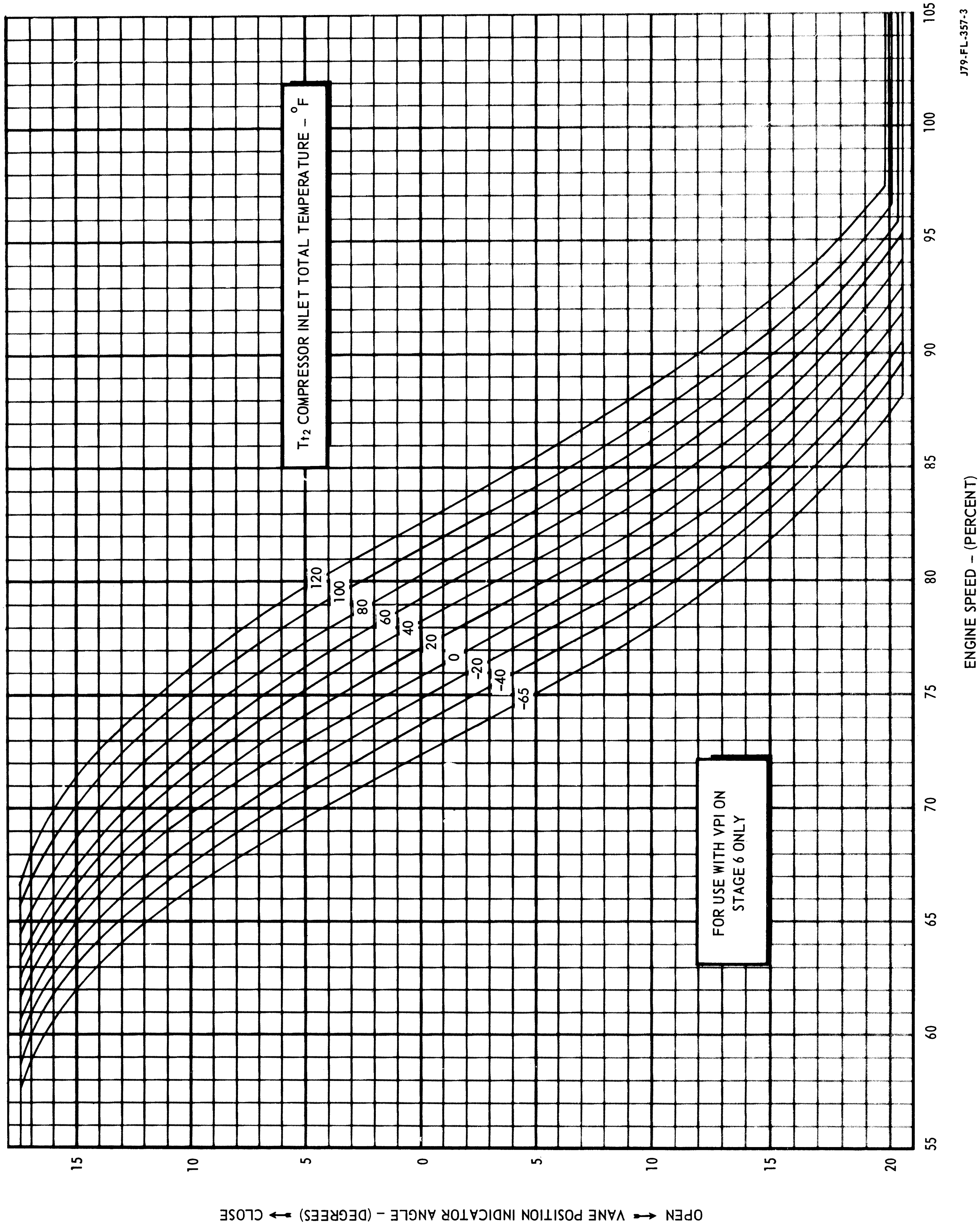


Figure 2-20. Variable Vane Schedule

4C-2-8-(16)

JETCAL INITIAL OPERATING PROCEDURES

GENERAL

TO ASSURE THAT AN ENGINE IS OPERATING AT THE CORRECT EGT, BOTH THE INDICATOR AND THE TEMPERATURE AMPLIFIER THERMOCOUPLE SYSTEMS MUST OPERATE WITHIN SPECIFIED LIMITS. THE JETCAL ANALYZER PROVIDES A RELIABLE MEANS OF DETERMINING SYSTEM ACCURACY AND ISOLATING SPECIFIC FAULTS. A FUNCTIONAL TEST OF THE EGT SYSTEM SHOULD BE PERFORMED: (1) WHEN TROUBLE SHOOTING EGT SYSTEM, (2) WHEN REQUIRED BY T.O. 1F-4C-6 INSPECTION REQUIREMENTS OR (3) WHEN INSTALLING A NEW ENGINE. BEFORE MAKING ANY ADJUSTMENT TO EGT, THE SYSTEM SHOULD BE CHECKED USING THE JETCAL ANALYZER TO ASSURE SYSTEM ERRORS ARE WITHIN ALLOWABLE LIMITS.

THE PROCEDURES HAVE BEEN ASSIGNED AN ORDER OF PRIORITY AS FOLLOWS:

JETCAL CHECK PROCEDURE I
EXHAUST GAS TEMPERATURE SYSTEM FUNCTIONAL CHECK
JETCAL CHECK PROCEDURE II
EXHAUST GAS TEMPERATURE INDICATOR CHECK
JETCAL CHECK PROCEDURE III
TACHOMETER SYSTEM CHECK
JETCAL CHECK PROCEDURE IV
EXHAUST GAS TEMPERATURE ADJUSTMENT, SEE FIGURE 4-22

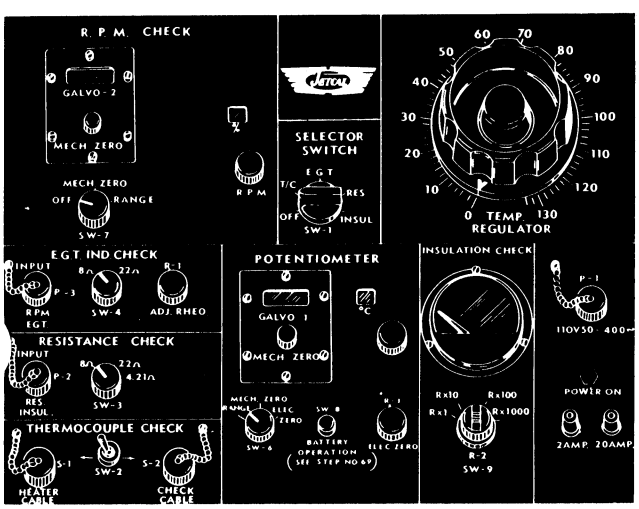
NOTE

PERFORM THE FOLLOWING STEPS PRIOR TO EACH OPERATIONAL CHECK. REFER TO JETCAL ANALYZER HANDBOOK OF OPERATION AND SERVICE INSTRUCTIONS FOR DETAILED OPERATING INSTRUCTIONS. AN EQUIVALENT JETCAL ANALYZER MAY BE USED IF APPROVED BY THE USING COMMAND AND PRESCRIBED HEATER PROBES ARE UTILIZED.

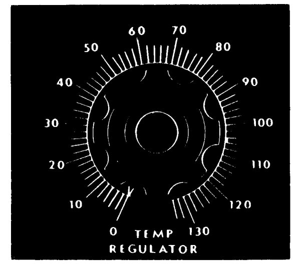
TOOLS AND TEST EQUIPMENT

JETCAL ANALYZER

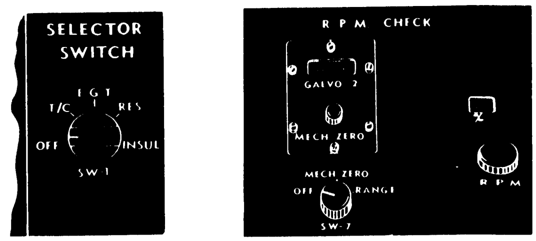
ELECTRICAL POWER SOURCE



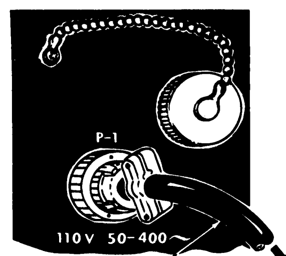
JETCAL ANALYZER BH112J



A SET TEMP. REGULATOR TO ZERO.



B PLACE SELECTOR SWITCH SW-1 AND SWITCH SW-7 IN OFF POSITION.



C CONNECT POWER INLET CABLE TO RECEPTACLE P-1 AND TO A 110 VOLT 50 TO 400 CYCLE, SINGLE PHASE POWER SOURCE. POWER ON LIGHT SHOULD ILLUMINATE.

WARNING

THE JETCAL ANALYZER PROBES UTILIZE WIRE WOUND COILS AND OPERATE ON AC POWER. THIS RESULTS IN AN INDUCED VOLTAGE ON THE CASE THAT CAN BE DISCHARGED IF THE EQUIPMENT IS NOT GROUNDED. FOR THE OPERATOR'S PROTECTION, GROUND THE PIGTAIL LEAD OF THE POWER INLET CABLE AT THE POWER SOURCE. FOR THE OPERATOR'S PROTECTION, GROUND THE POWER INLET CABLE AT THE POWER SOURCE.

4C-2-8-(172)A

Figure 2-21. BH112J or JA Jetcal Analyzer - Initial Jetcal Operating Procedures

JETCAL CHECK PROCEDURE 1

NOTE

PREPARE THE JETCAL ANALYZER BY PERFORMING THE INITIAL STEPS SHOWN ON THE JETCAL INITIAL OPERATING PROCEDURES ILLUSTRATION.

TOOLS AND TEST EQUIPMENT

JETCAL ANALYZER .... BH112J OR BH112J/A
CONTINUITY PROBE BH3810-40
ADAPTER, CABLE CHECK BH5430
EXTENSION HANDLE
COVER, EXHAUST NOZZLE
ELECTRICAL POWER SOURCE
HEATER CABLE BH405
CHECK CABLE BH450
JUNCTION BOX BH361-12
HEATER PROBE BH3801A-40

NOTE

AN EQUIVALENT JETCAL ANALYZER MAY BE USED PROVIDING IT HAS BEEN APPROVED BY THE USING COMMAND AND THE PRESCRIBED HEATER PROBES ARE UTILIZED.

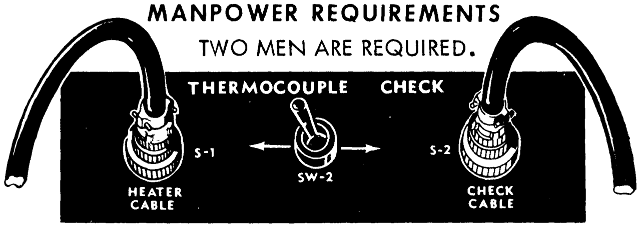
THE FUNCTIONAL CHECK OF THE EXHAUST GAS TEMPERATURE SYSTEM TESTS BOTH THE INDICATOR AND AMPLIFIER THERMOCOUPLES INDIVIDUALLY AND COLLECTIVELY. THE COMPLETE CHECK CONSISTS OF A COLD INSULATION RESISTANCE CHECK, INDIVIDUAL HEATER PROBE CHECK, INDIVIDUAL THERMOCOUPLE CHECK, THERMOCOUPLE HARNESS AND HOT RESISTANCE CHECK.

MATERIALS

LOCKWIRE, MS20995NC20

MANPOWER REQUIREMENTS

TWO MEN ARE REQUIRED.



CHECK PROCEDURE 1A
(COLD INSULATION RESISTANCE CHECK)

A ACCOMPLISH A COLD INSULATION RESISTANCE CHECK AS FOLLOWS:

(1) DISCONNECT THE THERMOCOUPLE LEAD AT THE TEMPERATURE AMPLIFIER. DISCONNECT THE COCKPIT INDICATOR LEAD AT THE ENGINE ELECTRICAL DISCONNECT BRACKET. ASSURE THAT ALL OTHER CONNECTORS IN THE THERMOCOUPLE SYSTEM ARE PROPERLY CONNECTED.

(2) MEASURE RESISTANCE BETWEEN PIN A OF THERMOCOUPLE LEAD AT AMPLIFIER DISCONNECT AND GROUND.

(3) MEASURE RESISTANCE BETWEEN PIN A OF THERMOCOUPLE LEAD AT INDICATOR DISCONNECT AND GROUND.

(4) MEASURE RESISTANCE BETWEEN PIN A AT AMPLIFIER DISCONNECT AND PIN A AT INDICATOR DISCONNECT.

NOTE

RESISTANCE IN EACH OF THE ABOVE CHECKS MUST BE AT LEAST 1250 OHMS. IF RESISTANCE IS 1250 OHMS OR MORE, RESISTANCE CHECK OF THE INDIVIDUAL COMPONENTS IS NOT REQUIRED. IF RESISTANCE IS LESS THAN 1250 OHMS, DISCONNECT ALL CONNECTORS IN THE SYSTEM AND CLEAN THE CONTACTS. RECONNECT THE SYSTEM AND REPEAT STEPS (1) THROUGH (4) ABOVE. IF RESISTANCE IS STILL LESS THAN 1250 OHMS, ACCOMPLISH AN INDIVIDUAL RESISTANCE CHECK ON THE SYSTEM COMPONENTS.

CHECK PROCEDURES 1B
(INDIVIDUAL HEATER PROBE CHECK)

B PERFORM AN INDIVIDUAL CHECK OF THE THERMOCOUPLE IN EACH HEATER PROBE AS FOLLOWS:

WARNING

DUE TO THE POSSIBILITY OF AN INDUCED VOLTAGE BEING PRESENT ON THE JETCAL CASE, THE POWER INLET CABLE SHOULD BE CONNECTED TO GROUND IN ACCORDANCE WITH AIR FORCE STANDARDS.

NOTE

THE FOLLOWING PROCEDURE IS FOR MODEL BH112J OR BH112JA JETCAL ANALYZERS. IF A DIFFERENT MODEL IS USED, CONSULT THE APPROPRIATE MANUAL OR INSTRUCTIONS PROVIDED WITH THE ANALYZER.

4C-2-8-(177-1)B

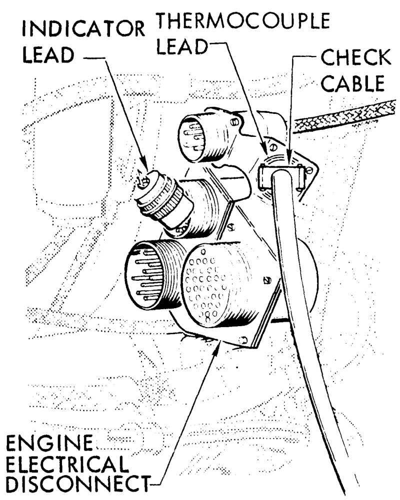
Figure 2-22. BH112J or JA Jetcal Analyzer - Exhaust Gas Temperature System Functional Check (Jetcal Check Procedure I) (Sheet 1 of 4)

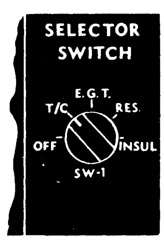
(1) WITH TEMPERATURE REGULATOR ON ZERO AND SELECTOR SWITCH SW-1 IN OFF POSITION, CONNECT THE POWER INLET CABLE TO JETCAL RECEPTACLE P-1. CONNECT TO A 95 TO 135 VOLTS 50 TO 400 CYCLE POWER SOURCE.

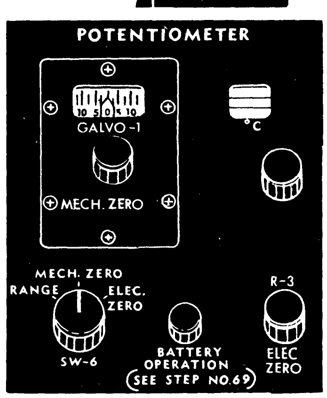
2) CONNECT HEATER PROBE CABLE TO JUNCTION BOX AND TO JETCAL RECEPTACLE S-1.

CAUTION

EACH TYPE OF THERMOCOUPLE HAS A SPECIALLY DESIGNED PROBE. USE ONLY PROBES DESIGNED FOR THE THERMOCOUPLES BEING TESTED. USE PROBES WITH IDENTICAL PART NUMBERS TO PREVENT ERRONEOUS READINGS.







(3) CONNECT ONE JETCAL HEATER PROBE, PART NO. BH3801A-40 TO HEATER PROBE JUNCTION BOX.

(4) TURN SELECTOR SWITCH SW-1 TO THERMOCOUPLE (T/C) POSITION.

(5) TURN SWITCH SW-2 TO S-1 POSITION.

(6) SET UP POTENTIOMETER AS FOLLOWS:

a. TURN SWITCH SW-6 TO MECH ZERO POSITION. ZERO GALVO-1 BY TURNING MECH ZERO KNOB.

NOTE

MODEL BH112JA DOES NOT HAVE ELEC ZERO POSITION.

b. HOLD SWITCH SW-6 IN ELEC ZERO POSITION. ZERO GALVO-1 BY TURNING ELEC ZERO KNOB R-3.

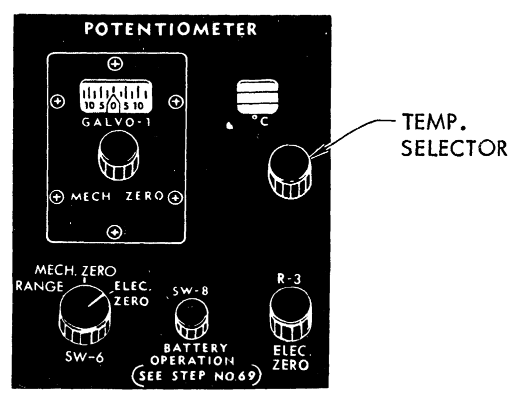
(7) PLACE SWITCH SW-6 IN RANGE POSITION AND ADJUST THE TEMPERATURE SELECT KNOB UNTIL GALVO-1 READS ZERO. THE POTENTIOMETER SHOULD READ AMBIENT TEMPERATURE (15°C ON STANDARD DAY). THIS CHECKS THE POTENTIOMETER.

(8) ROTATE TEMP REGULATOR KNOB CLOCKWISE. A DEFLECTION OF GALVO-1 TO THE RIGHT SHOULD BE NOTED AND INDICATES A GOOD THERMOCOUPLE IN THE PROBE.

(9) ROTATE TEMP REGULATOR KNOB TO ZERO.

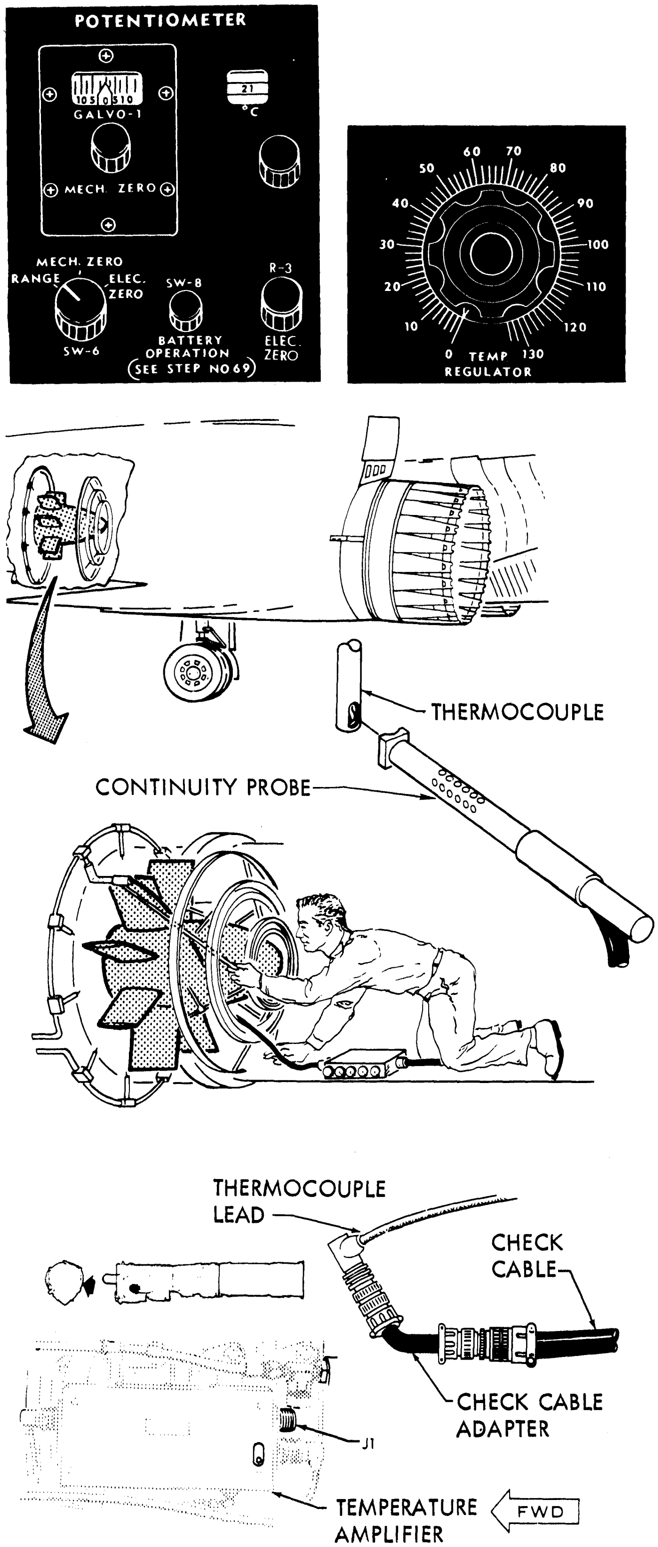
(10) DISCONNECT THE HEATER PROBE OBSERVING THAT GALVO-1 RETURNS TO ZERO. THIS CHECKS THE HEATER PROBE THERMOCOUPLE AND ENSURES CORRECT OPERATION OF JETCAL UNIT.

(11) REPEAT STEPS 8, 9 AND 10 FOR EACH HEATER PROBE.



4C-2-8-(177-2)C

Figure 2-22. BH112J or JA Jetcal Analyzer - Exhaust Gas Temperature System Functional Check (Jetcal Check Procedure I) (Sheet 2 of 4)



CHECK PROCEDURES 1C (INDIVIDUAL THERMOCOUPLE CHECK)

C PERFORM THE INDIVIDUAL THERMOCOUPLE CHECK AS FOLLOWS:

NOTE

THE SEPARATION BETWEEN DUAL LOOPS MUST NOT BE LESS THAN 0.015 INCHES. IF LESS THAN 0.015 INCHES SEPARATION EXISTS, SPREAD THE LOOPS TO A MAXIMUM OF ONE WIRE WIDTH.

(1) CONNECT CHECK CABLE TO ENGINE THERMOCOUPLE LEAD AT THE ENGINE ELECTRICAL DISCONNECT BRACKET AND TO JETCAL RECEPTACLE S-2.

(2) CONNECT HEATER CABLE TO THE CONTINUITY PROBE. AN ALTERNATE METHOD IS TO CONNECT THE HEATER CABLE TO THE JUNCTION BOX AND CONNECT ONE JETCAL HEATER PROBE TO THE JUNCTION BOX.

CAUTION

NEVER ALLOW HEATER PROBE TEMPERATURE TO EXCEED 750°C.

(3) PLACE SWITCH SW-2 IN S-1 POSITION AND ADJUST TEMPERATURE REGULATOR TO BRING THE ONE HEATER PROBE TO MILITARY RATED TEMPERATURE AS READ ON THE JETCAL.

(4) PLACE SWITCH SW-2 IN S-2 POSITION AND TURN THE TEMPERATURE SELECTOR KNOB TO RE-ZERO THE GALVANOMETER.

CAUTION

EXERCISE CARE WHEN ENTERING THE NOZZLE ASSEMBLY TO AVOID DAMAGING THE FLAPS.

NOTE

TWO MEN WILL BE REQUIRED, ONE TO FLASH THE THERMOCOUPLE AND ONE TO OBSERVE FOR GALVO DEFLECTION. ALSO, A SLIGHT ADJUSTMENT OF THE TEMPERATURE SELECTOR KNOB WILL BE REQUIRED TO KEEP THE GALVO IN RANGE AS THE THERMOCOUPLES HEAT SOAK.

(5) CAREFULLY PLACE THE HOT HEATER PROBE OVER EACH THERMOCOUPLE INDIVIDUALLY. A DEFLECTION OF GALVO-1 TO THE RIGHT INDICATES THAT THE THERMOCOUPLE IS OPERATING. A DEFLECTION TO THE LEFT INDICATES CROSSED THERMOCOUPLE WIRES AND NO DEFLECTION INDICATES AN OPEN CIRCUIT. IF ANY DEFECTS ARE NOTED, REPLACE THE HALF RING CONTAINING THE FAULTY THERMOCOUPLE.

(6) REMOVE CHECK CABLE FROM THERMOCOUPLE LEAD AT ENGINE ELECTRICAL DISCONNECT BRACKET.

(7) DISCONNECT THERMOCOUPLE LEAD AT TEMPERATURE AMPLIFIER AND CONNECT CHECK CABLE ADAPTER BH5430 TO THERMOCOUPLE LEAD AT THIS POINT. CONNECT CHECK CABLE TO CHECK CABLE ADAPTER.

(8) REPEAT STEP (5) TO CHECK AMPLIFIER THERMOCOUPLES.

4C-2-8-(177-3)

Figure 2-22. BH112J or JA Jetcal Analyzer - Exhaust Gas Temperature System Functional Check (Jetcal Check Procedure I) (Sheet 3 of 4)

(9) PLACE SWITCH SW-6 IN MECH ZERO POSITION AND SWITCH SW-2 IN S-1 POSITION. TURN TEMPERATURE REGULATOR TO ZERO. PROCEED TO THERMOCOUPLE HARNESS CHECK.

CHECK PROCEDURE 1D
(THERMOCOUPLE HARNESS CHECK)

D PERFORM A CHECK OF THE THERMOCOUPLE HARNESS AS FOLLOWS:

(1) CAREFULLY PLACE A HEATER PROBE OVER EACH THERMOCOUPLE. AS EACH PROBE IS PLACED OVER A THERMOCOUPLE, CONNECT ITS CABLE TO THE HEATER PROBE JUNCTION BOX. PROBES MUST BE PUSHED COMPLETELY ON THE THERMOCOUPLES (RECHECK AFTER ALL CONNECTIONS HAVE BEEN MADE).

NOTE

IF TEST IS ACCOMPLISHED DURING WINDY OR COLD WEATHER, IT IS ADVISABLE TO PLACE A COVER OVER THE EXHAUST NOZZLE.

(2) PLACE SWITCH SW-6 IN RANGE POSITION AND SWITCH SW-2 IN S-1 POSITION.

(3) ADJUST TEMPERATURE REGULATOR TO BRING HEATER PROBES TO MILITARY RATED EGT. AFTER THE TEMPERATURE STABILIZES ZERO GALVO-1, READ JETCAL POTENTIOMETER AND NOTE THE TEMPERATURE.

(4) PLACE SWITCH SW-2 TO THE S-2 POSITION AND ADJUST THE TEMPERATURE SELECTOR KNOB UNTIL GALVO-1 ZEROS. THE TEMPERATURE NOW INDICATED ON THE POTENTIOMETER SHOULD BE WITHIN 10°C OF THE TEMPERATURE NOTED IN STEP (3).

(5) DISCONNECT THE CHECK CABLE FROM CHECK CABLE ADAPTER BH5430 AND CONNECT CHECK CABLE TO THE INDICATOR THERMOCOUPLE LEAD AT THE ENGINE ELECTRICAL DISCONNECT BRACKET.

(6) PLACE SWITCH SW-2 TO S-1 POSITION AND ADJUST THE TEMPERATURE SELECTOR KNOB UNTIL GALVO-1 INDICATES ZERO. NOTE TEMPERATURE ON THE POTENTIOMETER. PLACE SWITCH SW-2 TO S-2 POSITION AND ADJUST TEMPERATURE SELECTOR KNOB UNTIL GALVO-1 READS ZERO. THE TEMPERATURE INDICATED ON THE POTENTIOMETER SHOULD BE WITHIN 10°C OF THE READING OBTAINED WITH SWITCH SW-2 IN S-1 POSITION.

(7) IF THE TEMPERATURE SPREAD IN STEP (4) OR (6) EXCEEDS 10°C, TROUBLE SHOOT THE THERMOCOUPLE CIRCUIT IN ACCORDANCE WITH T.O. 2J-J79-46.

(8) REMOVE THE CHECK CABLE FROM THE THERMOCOUPLE INDICATOR LEAD AND ADAPTER BH5430 FROM THE THERMOCOUPLE AMPLIFIER LEAD. PROCEED TO THE HOT INSULATION CHECK.

CHECK PROCEDURE 1E
(HOT INSULATION CHECK)

E PERFORM THE HOT INSULATION CHECK AS FOLLOWS:

NOTE

BOTH THE THERMOCOUPLE INDICATOR AND AMPLIFIER LEADS SHOULD ALREADY BE DISCONNECTED, HEATER PROBE INSTALLED AND STABILIZED AT MILITARY RATED EGT.

(1) MEASURE THE RESISTANCE BETWEEN PIN A OF THE THERMOCOUPLE LEAD AT THE AMPLIFIER DISCONNECT AND GROUND.

(2) MEASURE THE RESISTANCE BETWEEN PIN A OF THE THERMOCOUPLE LEAD AT THE INDICATOR DISCONNECT AND GROUND.

(3) MEASURE THE RESISTANCE BETWEEN PIN A AT AMPLIFIER DISCONNECT AND PIN A AT INDICATOR DISCONNECT.

(4) IF THE RESISTANCE NOTED IN STEPS (1), (2) OR (3) IS LESS THAN 250 OHMS, TROUBLESHOOT THE THERMOCOUPLE CIRCUIT IN ACCORDANCE WITH T.O. 2J-J79-46.

(5) AFTER COMPLETION OF THE RESISTANCE CHECK, PLACE SWITCH SW-6 TO MECH ZERO POSITION AND ROTATE THE TEMPERATURE REGULATOR TO ZERO.

(6) PLACE SWITCH SW-1 IN OFF POSITION. REMOVE HEATER PROBES AND CABLES FROM THE ENGINE AND THE ANALYZER. RECONNECT ALL ENGINE LEADS AND SECURE WITH LOCKWIRE.

CAUTION

ALLOW HEATER PROBES TO COOL PRIOR TO STORAGE.

F QUALITY ASSURANCE SUMMARY.

(1) ASSURE THAT HEATER PROBES AND CABLES ARE REMOVED FROM THE ENGINE.

(2) ASSURE THAT THE INDICATOR AND TEMPERATURE AMPLIFIER THERMOCOUPLE LEADS ARE PROPERLY CONNECTED AND LOCKWIRED.

(3) ASSURE JETCAL ACCOMPLISHMENT IS RECORDED ON AFTO FORM 781N.

4C-2-8-(177-4)C

Figure 2-22. BH112J or JA Jetcal Analyzer - Exhaust Gas Temperature System Functional Check (Jetcal Check Procedure I) (Sheet 4 of 4)

JETCAL CHECK PROCEDURE II

NOTE

PREPARE JETCAL ANALYZER BY PERFORMING INITIAL STEPS SHOWN ON JETCAL INITIAL OPERATING PROCEDURES.

TOOLS AND TEST EQUIPMENT

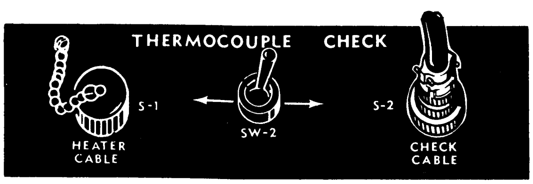
JETCAL ANALYZER .... BH112J OR BH112J/A
CHECK CABLE BH450
CHECK CABLE ADAPTER BH5430
POWER SOURCE, EXTERNAL ELECTRICAL

MATERIALS

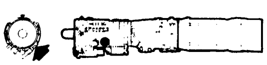
LOCKWIRE, MS20995NC20

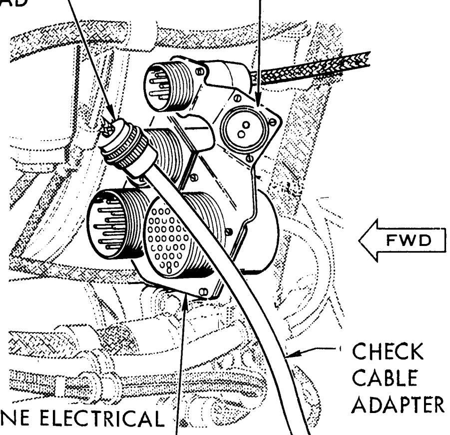
MANPOWER REQUIREMENT

TWO MEN REQUIRED.



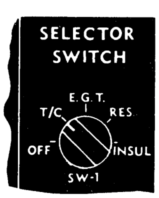
A CONNECT CHECK CABLE TO S-2 ON ANALYZER AND PLACE SW-2 IN S-2.

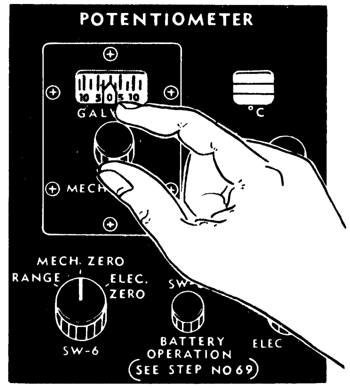




B REMOVE LOCKWIRE AND DISCONNECT INDICATOR LEAD AT ENGINE ELECTRICAL DISCONNECT. CONNECT ONE END OF CHECK CABLE ADAPTER TO INDICATOR LEAD, AND CONNECT OTHER END TO CHECK CABLE.

C PLACE SW-1 IN T/C.





D PLACE SW-6 IN MECH. ZERO, AND ADJUST MECH. ZERO KNOB UNTIL GALVO-1 READS ZERO.

E HOLD SW-6 IN ELEC. ZERO, AND ADJUST ELEC. ZERO (R-3) KNOB UNTIL GALVO-1 READS ZERO.

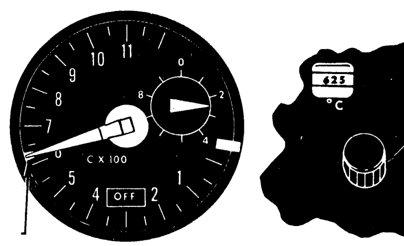
F APPLY EXTERNAL ELECTRICAL POWER TO AIRPLANE.

G PLACE SW-6 IN RANGE AND ADJUST TEMP. SELECTOR KNOB TO TEST TEMPERATURE 625°C.

NOTE

TAP INSTRUMENT PANEL LIGHTLY WITH FINGERS TO REDUCE FRICTION ERROR IN INDICATOR.

H COCKPIT EGT INDICATOR SHOULD COINCIDE WITH °C SCALE ON JETCAL ANALYZER WITHIN ± 5°C.



COCKPIT EGT INDICATOR

CAUTION

PLACE SW-6 IN MECH. ZERO AND PLACE SELECTOR SWITCH SW-1 IN OFF POSITION BEFORE REMOVING CABLES FROM ENGINE AND ANALYZER.

I REMOVE CHECK CABLE AND CHECK CABLE ADAPTER FROM ENGINE.

J CONNECT INDICATOR LEAD AT ENGINE ELECTRICAL DISCONNECT AND SECURE WITH LOCKWIRE.

K REMOVE EXTERNAL ELECTRICAL POWER FROM AIRPLANE.

L ASSURE JETCAL ACCOMPLISHMENT IS RECORDED ON AFTO FORM 781N.

4C-2-8-(176)B

Figure 2-23. BH112J or JA Jetcal Analyzer - Exhaust Gas Temperature Indicator Check (Jetcal Check Procedure II)

JETCAL CHECK PROCEDURE III

NOTE

PREPARE JETCAL ANALYZER BY PERFORMING INITIAL STEPS SHOWN ON JETCAL INITIAL OPERATING PROCEDURES.

TOOLS AND TEST EQUIPMENT

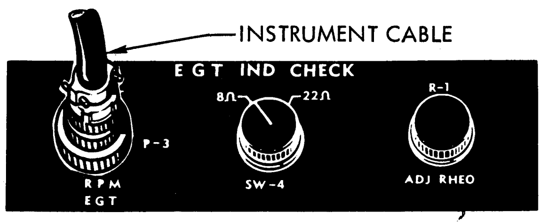
JETCAL ANALYZER .... BH112J OR BH112J/A
RPM CHECK ADAPTER BH907-85
INSTRUMENT CABLE ASSEMBLY............ BH485

MATERIALS

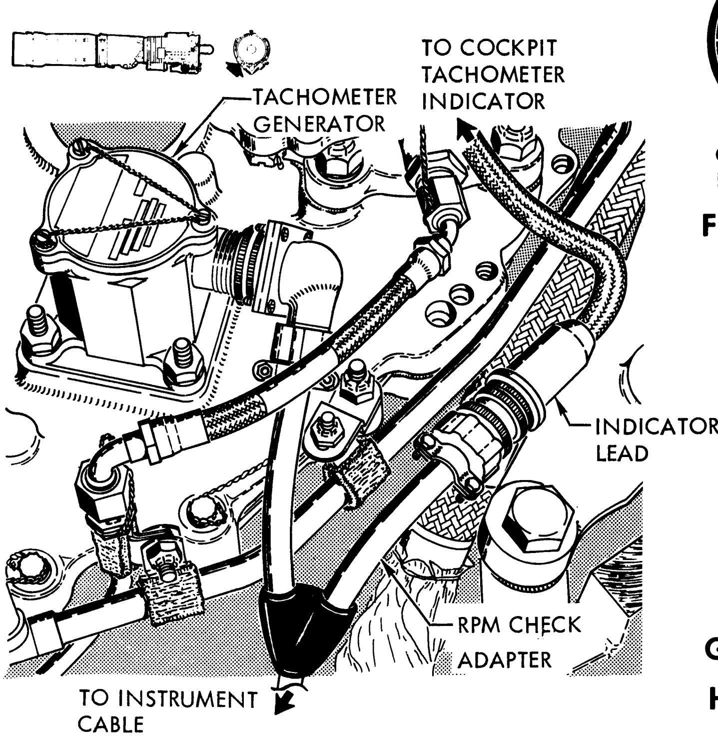
LOCKWIRE, MS20995NC20

MANPOWER REQUIREMENT

TWO MEN REQUIRED

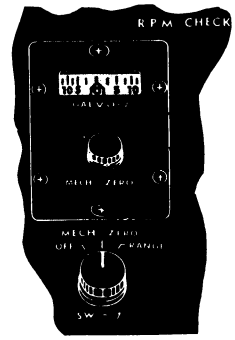


A CONNECT INSTRUMENT CABLE TO RECEPTACLE P-3.



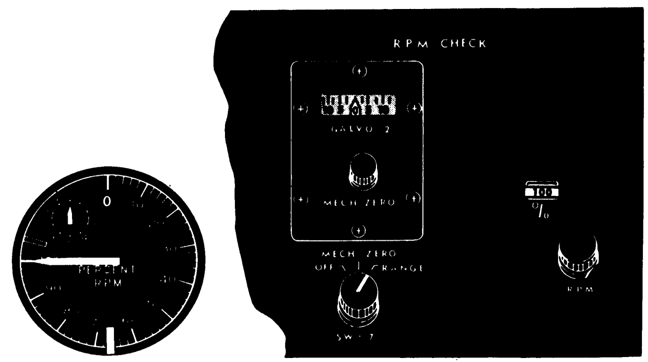
B REMOVE LOCKWIRE AND DISCONNECT INDICATOR LEAD FROM TACHOMETER GENERATOR AND CONNECT RPM CHECK ADAPTER TO TACHOMETER GENERATOR AND TO INDICATOR LEAD AS SHOWN. CONNECT THIRD END OF ADAPTER TO INSTRUMENT CABLE.

C PLACE SW-7 IN MECH. ZERO AND ADJUST MECH. ZERO UNTIL GALVO-2 READS ZERO.



D PLACE SW-7 IN RANGE.

E START ENGINE AND MONITOR ENGINE R P M USING TACHOMETER INDICATOR IN FWD COCKPIT.



COCKPIT TACHOMETER INDICATOR

F R P M READINGS ARE MADE BY ADJUSTING R P M KNOB UNTIL GALVO-2 READS ZERO. R P M READING APPEARS ON % SCALE. (DIFFERENCE BETWEEN SCALE READING AND TACHOMETER INDICATOR READING IS INDICATED ERROR OF TACHOMETER INDICATING SYSTEM. ERROR SHOULD NOT EXCEED 0.5% RPM).

CAUTION

PLACE SW-7 OFF BEFORE REMOVING CABLES FROM ENGINE AND ANALYZER.

G SHUT DOWN ENGINE AND PLACE SW-7 OFF.

H REMOVE RPM CHECK ADAPTER FROM ENGINE.

I CONNECT INDICATOR LEAD TO TACHOMETER GENERATOR AND SECURE WITH LOCKWIRE.

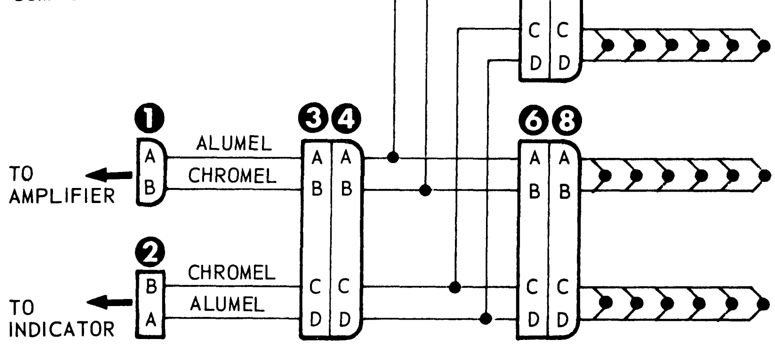
J ASSURE JETCAL ACCOMPLISHMENT IS RECORDED ON AFTO FORM 781N.

4C-2-8-(175)B

Figure 2-24. BH112J or JA Jetcal Analyzer - Tachometer System Check (Jetcal Check Procedure III)

NOTE

LOOSEN THE NECESSARY RETAINING CLAMPS AND DISCONNECT THE CIRCUITRY AT 1, 2, 3, 5, AND 6. USE AN OHMMETER OR WHEATSTONE BRIDGE, OR EQUIVALENT, TO MAKE THE CHECKS TABULATED BELOW. REPLACE DEFECTIVE COMPONENTS.



PIN CHECK	RESISTANCE-OHMS
CHECK THE FOLLOWING AT 3:	
EACH PIN TO GROUND	100,000 MINIMUM
EACH PIN TO EVERY OTHER PIN	100,000 MINIMUM
*A TO B AND C TO D - WITH A TO B JUMPERED AT 1 AND 2	1 OHM, MAXIMUM
CHECK THE FOLLOWING AT 4:	
EACH PIN TO GROUND	100,000 MINIMUM
EACH PIN TO EVERY OTHER PIN	50,000 MINIMUM
CHECK THE FOLLOWING AT 5 AND 6 WITH A TO B AND C TO D JUMPERED AT 4:	
*A TO B AND C TO D	1 OHM, MAXIMUM
CHECK THE FOLLOWING AT 7 AND 8:	
EACH PIN TO GROUND (COLD)	2 500 MINIMUM
EACH PIN TO GROUND (600°C - JETCAL)	500 MINIMUM
A OR B TO C OR D (COLD)	2 500 MINIMUM
A OR B TO C OR D (600°C — JETCAL)	500 MINIMUM
*A TO B AND C TO D	1.76-2.16 OHMS

* THESE CHECKS ARE TO BE MADE WITH THE METER LEADS CONNECTED TO THE APPROPRIATE CONNECTOR THROUGH A MATING SLAVE CONNECTOR OR BY USING PINS OF THE PROPER SIZE TAKEN FROM A CONNECTOR. AS THE RESISTANCE IS BEING READ, GENTLY REMOVE THE MATING CONNECTOR OR PINS WHILE WIGGLING THEM BACK AND FORTH IN ALL DIRECTIONS. ANY ERRATIC METER DEFLECTION OR LOSS OF CONTINUITY IS AN INDICATION OF LOOSENESS IN THE WELD JOINT BETWEEN THE WIRE AND ITS PIN AND THE COMPONENT SHOULD BE REJECTED.

J79-A6326-2-A2A

4C-2-8-(39)

Figure 2-25. BH112J or JA Jetcal Analyzer - Thermocouple Check

NOTE

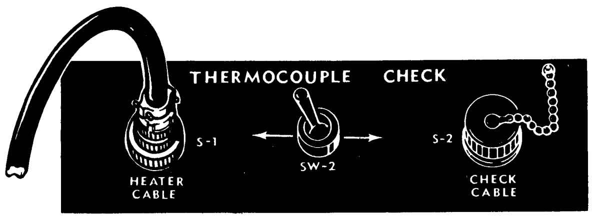
PREPARE JETCAL ANALYZER BY PERFORMING INITIAL STEPS SHOWN ON JETCAL INITIAL OPERATING PROCEDURES.

TOOLS AND TEST EQUIPMENT

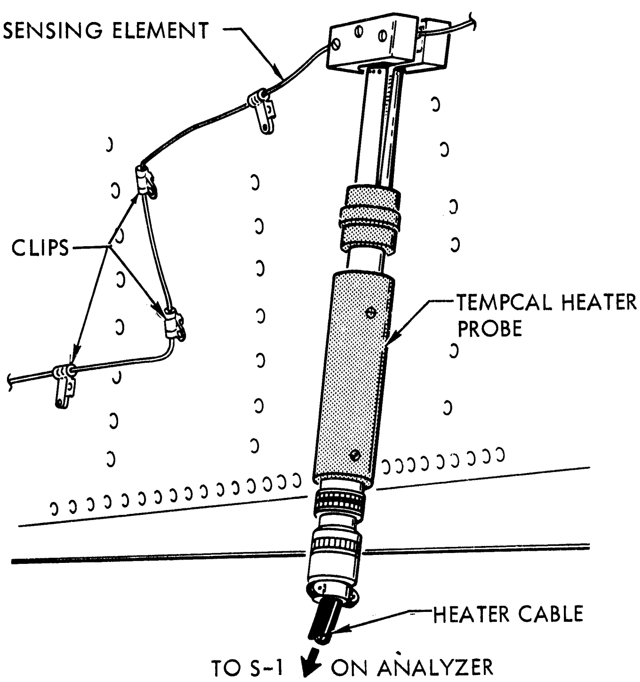
JETCAL ANALYZER .... BH112J OR BH112J/A
TEMPCAL HEATER PROBE BH1278
HEATER CABLE ASSEMBLY BH405
POWER SOURCE, EXTERNAL ELECTRICAL

MANPOWER REQUIREMENT

TWO MEN REQUIRED.



A CONNECT HEATER CABLE TO RECEPTACLE S-1 ON ANALYZER AND PLACE SW-2 IN S-1.

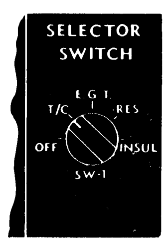


B CONNECT TEMPCAL HEATER PROBE TO HEATER CABLE, AND CLAMP PROBE OVER THE SENSING ELEMENT TO BE TESTED.

C PLACE SW-1 IN T/C.

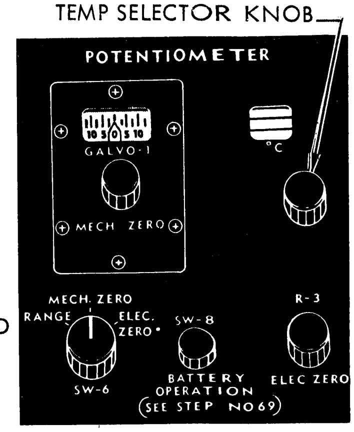
D PLACE SW-6 IN MECH. ZERO, AND ADJUST MECH. ZERO KNOB UNTIL GALVO-1 READS ZERO.

E HOLD SW-6 IN ELEC. ZERO POSITION, AND ADJUST ELEC. ZERO (R-3) KNOB UNTIL GALVO-1 READS ZERO.



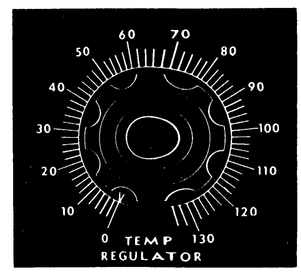
F PLACE SW-6 IN RANGE.

G TEMPERATURE READINGS ARE MADE BY ADJUSTING THE TEMP SELECTOR KNOB (UNMARKED KNOB NEAR °C WINDOW) UNTIL GALVO-1 READS ZERO. TEMPERATURE READING APPEARS ON °C SCALE (WITH TEMPCAL HEATER PROBE COLD, AND GALVO-1 ZEROED, °C SCALE SHOULD READ AMBIENT TEMPERATURE.)



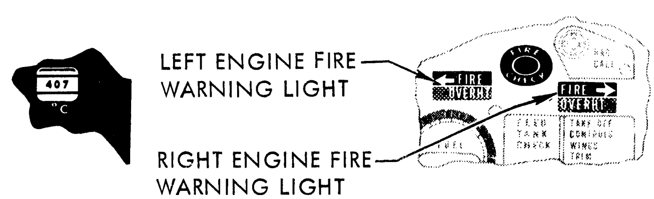
H APPLY EXTERNAL ELECTRICAL POWER TO AIRCRAFT.

I SET TEMP. REGULATOR DIAL TO APPROXIMATELY 100. TO STABILIZE JETCAL, INCREASE TEMPERATURE OF TEMPCAL HEATER PROBE BY INCREASING SELECTION OF TEMP. REGULATOR. KEEP GALVO-1 POINTER CENTERED BY USE OF °C CONTROL KNOB WHILE SENSING ELEMENT IS HEATING. WHEN APPROXIMATELY 595°C APPEARS IN °C WINDOW, SLOWLY DECREASE RATE OF HEATING OF SENSING ELEMENT TO BELOW 387°C BY DECREASING TEMP. REGULATOR. HEAT SENSING ELEMENTS AT A SLOWER RATE UNTIL FIRE WARNING LIGHT ILLUMINATES IN PILOT'S COCKPIT.



CAUTION

WHEN TESTING THE FIRE DETECTOR SYSTEM ON THE LEFT ENGINE, ASSURE THAT THE LEFT WARNING LIGHT IN THE PILOT'S COCKPIT ILLUMINATES. CONVERSELY, ASSURE THAT THE RIGHT FIRE WARNING LIGHT ILLUMINATES WHEN TESTING THE FIRE DETECTOR SYSTEM ON THE RIGHT ENGINE.



J FIRE WARNING LIGHT SHOULD COME ON BETWEEN 387 AND 428 AS READ ON °C SCALE AND REMAIN ON. WHEN TEMPERATURE OF ABOUT 595°C IS READABLE IN °C WINDOW, SLOWLY BACK OFF TEMPERATURE REGULATOR UNTIL LIGHT GOES OUT.

4C—2—8—(174—1)B

Figure 2-26. BH112J or JA Jetcal Analyzer - Fire Detector System Test (Sheet 1 of 2)

K ROTATE TEMP. REGULATOR TOWARD ZERO AND ALLOW TEMPCAL HEATER PROBE TO COOL SLOWLY. FIRE WARNING LIGHT SHOULD GO OUT BEFORE °C SCALE REACHES 387.

L ROTATE TEMP. REGULATOR TO ZERO.

CAUTION

PLACE SW-6 IN MECH. ZERO AND PLACE SELECTOR SW-1 OFF BEFORE REMOVING HEATER CABLE FROM TEMPCAL HEATER PROBE AND ANALYZER.

M REMOVE TEMPCAL HEATER PROBE FROM SENSING ELEMENT.

4C-2-8-(174-2)A

Figure 2-26. BH112J or JA Jetcal Analyzer - Fire Detector System Test (Sheet 2 of 2)

"All data on page 2-68A thru 2-68B deleted."

NOTE

PREPARE JETCAL ANALYZER BY PERFORMING INITIAL STEPS SHOWN ON THE JETCAL INITIAL OPERATING PROCEDURES.

TOOLS AND TEST EQUIPMENT

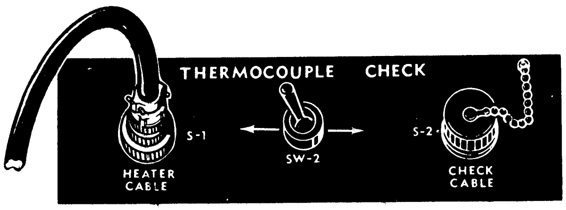
JETCAL ANALYZER .... BH112J OR BH112J/A
TEMPCAL HEATER PROBE BH1278
HEATER CABLE ASSEMBLE BH405
POWER SOURCE, EXTERNAL ELECTRICAL

MATERIALS

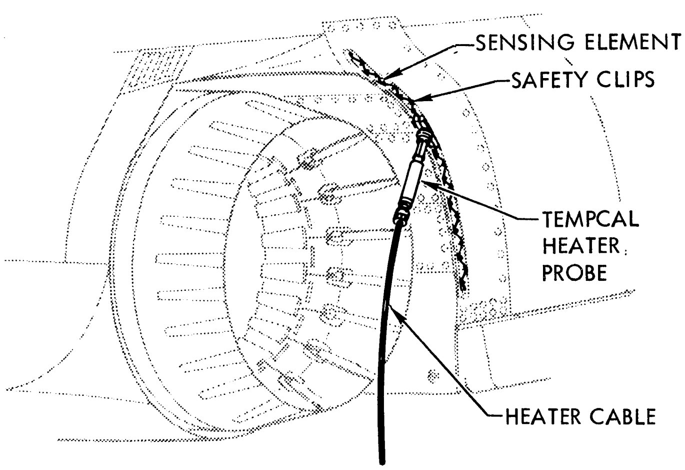
LOCKWIRE, MS20995NC20

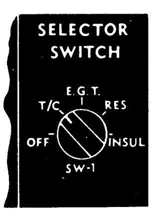
MANPOWER REQUIREMENT

TWO MEN REQUIRED



A CONNECT HEATER CABLE TO RECEPTACLE S-1 ON ANALYZER AND PLACE SW-2 IN S-1.





DETAIL A

B CONNECT TEMPCAL HEATER PROBE TO HEATER CABLE.

C PLACE SW-1 IN T/C.

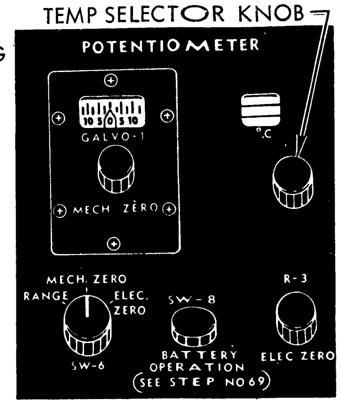
D PLACE SW-6 IN MECH. ZERO AND ADJUST MECH. ZERO KNOB UNTIL GALVO-1 READS ZERO.

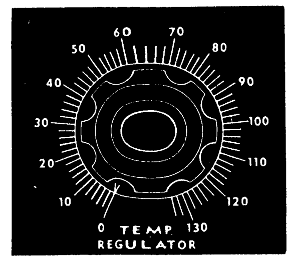
E HOLD SW-6 IN ELEC. ZERO AND ADJUST ELEC. ZERO (R-3) KNOB UNTIL GALVO-1 READS ZERO.

F PLACE SW-6 IN RANGE.

G TEMPERATURE READINGS ARE MADE BY ADJUSTING TEMP SELECTOR KNOB (UNMARKED KNOB NEAR THE °C WINDOW) UNTIL GALVO-1 READS ZERO. TEMPERATURE READING APPEARS ON °C SCALE. (WITH TEMPCAL HEATER PROBE COLD, AND GALVO-1 ZEROED, °C SCALE SHOULD READ AMBIENT TEMPERATURE.)

TEMP SELECTOR KNOB





NOTE

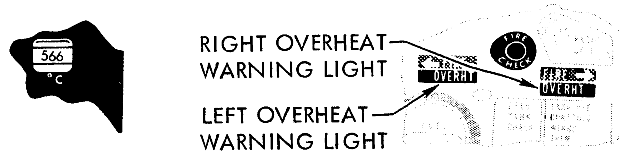
EXHAUST NOZZLE FLAPS MUST BE CLOSED TO PROVIDE ACCESS TO SENSING ELEMENT.

H REMOVE LOCKWIRE AND UNFASTEN THREE SENSING ELEMENT CLIPS AS SHOWN. THEN CLAMP TEMPCAL HEATER PROBE OVER THE SENSING ELEMENT.

I APPLY EXTERNAL ELECTRICAL POWER TO AIRCRAFT.

J INCREASE TEMPERATURE OF TEMPCAL HEATER PROBE BY TURNING TEMP. REGULATOR TO APPROXIMATELY 100. MANIPULATE TEMP. SELECTOR KNOB (UNMARKED KNOB NEAR 0°C WINDOW) WHILE KEEPING GALVO-1 POINTER CENTERED DURING TIME SENSING ELEMENT IS BEING HEATED. WHEN A TEMPERATURE OF ABOUT 595°C IS READABLE IN °C WINDOW, SLOWLY BACK OFF TEMP, REGULATOR UNTIL LIGHT COMES ON.

K OVERHEAT WARNING LIGHT SHOULD COME ON BETWEEN 536 AND 595 AS READ ON °C SCALE AND REMAIN ON.



L ROTATE TEMP. REGULATOR TOWARD ZERO AND ALLOW TEMPCAL HEATER PROBE TO COOL SLOWLY. WARNING LIGHT SHOULD GO OUT BEFORE °C SCALE REACHES 536.

M ROTATE TEMP REGULATOR TO ZERO.

CAUTION

PLACE SW-6 IN MECH. ZERO AND PLACE SW-1 OFF BEFORE REMOVING HEATER CABLE FROM TEMPCAL HEATER PROBE AND ANALYZER.

N REMOVE TEMPCAL HEATER PROBE FROM SENSING ELEMENT.

O FASTEN SENSING ELEMENT CLIPS AND LOCKWIRE.

4C-2-8-(173)A

Figure 2-27. BH112J or JA Jetcal Analyzer - Aft Fuselage Overheat Detector System Test

2-80A. **BH112JB-40 JETCAL ANALYZER/TRIMMER.** The BH112JB-40 Jetcal analyzer/trimmer ensures the engine and aircraft EGT, tachometer, fire warning and overheat detector systems are operating correctly and within specified limits. The analyzer/trimmer provides an accurate method for checking these systems and their components and will aid in isolating malfunctions within the engine or aircraft. The analyzer/trimmer displays the actual engine EGT and percent RPM during engine operation. When checking the fire warning and aft fuselage overheat detector systems, the analyzer/trimmer displays the actual temperatures at which these systems are activated. Also, the readings obtained from the analyzer/trimmer, when checked against aircraft indicator readings, provide an accurate reference for use in checkout, troubleshooting and adjustment. Required accessories used with the analyzer/trimmer to perform the checks and adjustments are shown in figure 2-27A. Cable part numbers, lengths, and accessory illustrations are given to aid identification. Also, each procedure lists by nomenclature and part number the test equipment, cables and components needed to perform the check. All controls and displays are shown for a basic orientation of the Jetcal analyzer/trimmer in figure 2-27A. The procedures in section II provide the system checkouts which can be performed in any sequence after the initial check of the analyzer/trimmer has been accomplished. In the EGT system, a functional check is to be performed when troubleshooting, when a new engine is installed, or when required by TO 1F-4C-6 inspection requirements. The complete EGT system functional check consists of the individual thermocouple check, thermocouple harness check, hot insulation resistance check and the thermocouple resistance check. The checkout procedures for section II and adjustment procedures for section IV are as follows:

a. BH112JB-40 Jetcal Analyzer/Trimmer-Initial Check. Ensures accuracy and correct operation of the analyzer/trimmer. This procedure must be performed before performing any of the checkout procedures.

b. BH112JB-40 Jetcal Analyzer/Trimmer-Individual Heater Probe Operational Check. Checks the correct operation and accuracy of the heater probes. This check must be performed before using the heater probes.

c. BH112JB-40 Jetcal Analyzer/Trimmer-Individual Thermocouple Check. Includes a cold insulation resistance check followed by a continuity check which tests both the temperature amplifier and engine EGT circuits in the thermocouple system.

d. BH112JB-40 Jetcal Analyzer/Trimmer-Thermocouple Harness Check. Checks engine thermocouples and the thermocouple harness for correct operation and accuracy by applying heat to all thermocouples at the same time.

e. BH112JB-40 Jetcal Analyzer/Trimmer-Hot Insulation Resistance Check. Checks the resistance of the insulating material in thermocouple system between conductors and aircraft ground while thermocouples are heated to MIL power temperature.

f. BH112JB-40 Jetcal Analyzer/Trimmer-Thermocouple Resistance Check. Checks the resistance of each segment of the engine thermocouple circuit wiring in the half rings, rigid lead and flexible lead between conductors and conductors to aircraft ground.

g. BH112JB-40 Jetcal Analyzer/Trimmer-Exhaust Gas Temperature Indicator Check. Compares aircraft EGT indicator reading with an accurate EGT input from the analyzer/trimmer to determine EGT indicating system error.

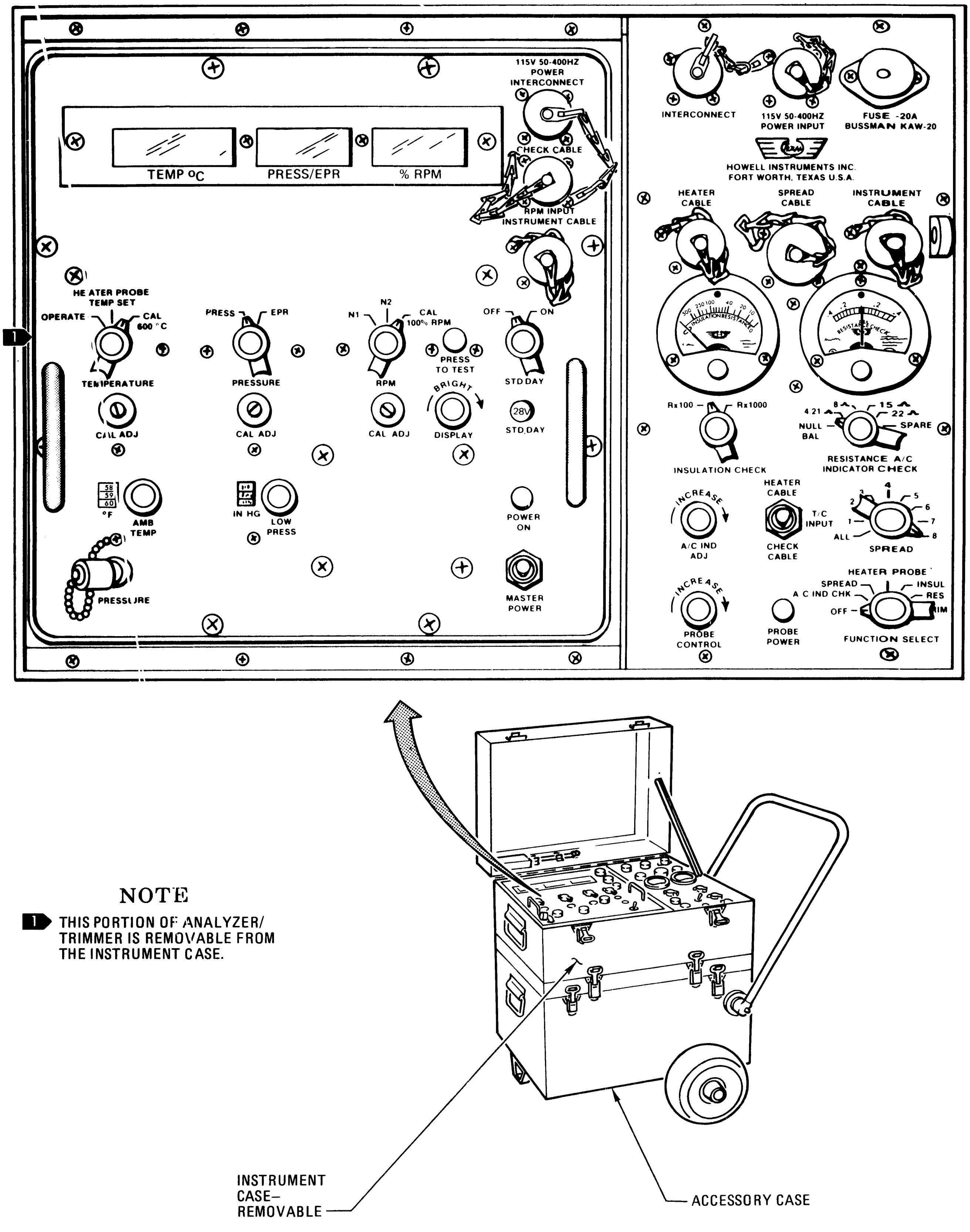
h. BH112JB-40 Jetcal Analyzer/Trimmer-Tachometer System Check. Checks the tachometer system during engine run by comparing actual engine RPM displayed on the analyzer/trimmer with the cockpit tachometer to determine the system error.

i. BH112JB-40 Jetcal Analyzer/Trimmer-Fire Detector System Test. Checks fire warning elements and related circuitry by applying a test temperature to the elements with analyzer/trimmer and checking for correct cockpit fire warning indication.

j. BH112JB-40 Jetcal Analyzer/Trimmer-Aft Fuselage Overheat Detector System Test. Checks aft fuselage overheat sensing elements and related circuitry by applying a test temperature to sensing elements with the analyzer/trimmer and checking for correct cockpit aft fuselage overheat indication.

k. BH112JB-40 Jetcal Analyzer/Trimmer-Engine Speed Adjustment (Section IV). This procedure uses the analyzer/trimmer to accurately adjust engine speed in percent RPM at IDLE and MIL power during engine run. The throttle system must be correctly rigged before performing this procedure.

l. BH112JB-40 Jetcal Analyzer/Trimmer-Exhaust Gas Temperature Adjustment (SectionIV). The final exhaust gas temperature adjustment is made in this procedure using the analyzer/trimmer during engine run. This procedure is not intended to replace the EGT system checks in section II.



NOTE

1 THIS PORTION OF ANALYZER/ TRIMMER IS REMOVABLE FROM THE INSTRUMENT CASE.

4C-2-8-(197-1)

Figure 2-27A. BH112JB-40 Jetcal Analyzer/Trimmer (Sheet 1 of 3)

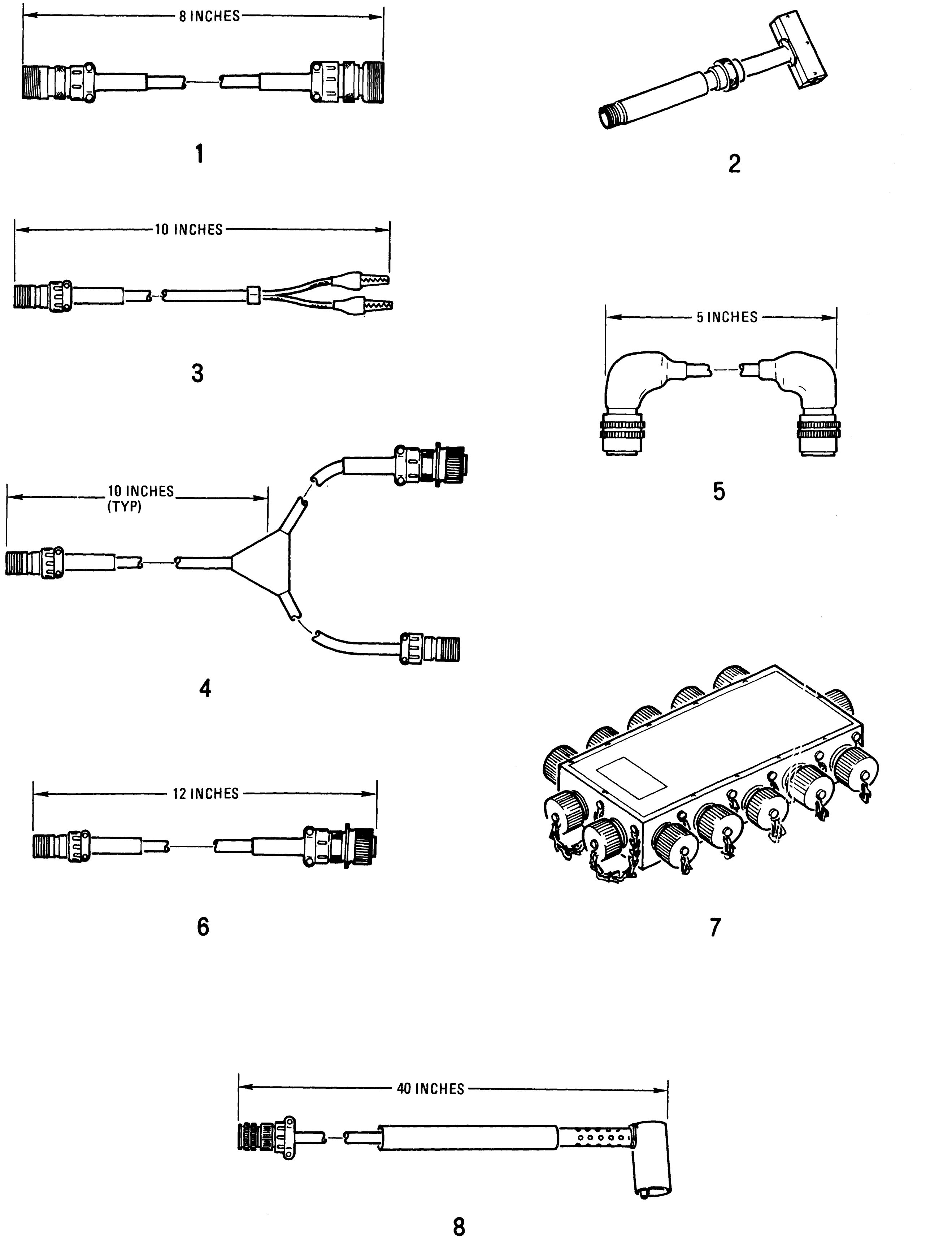
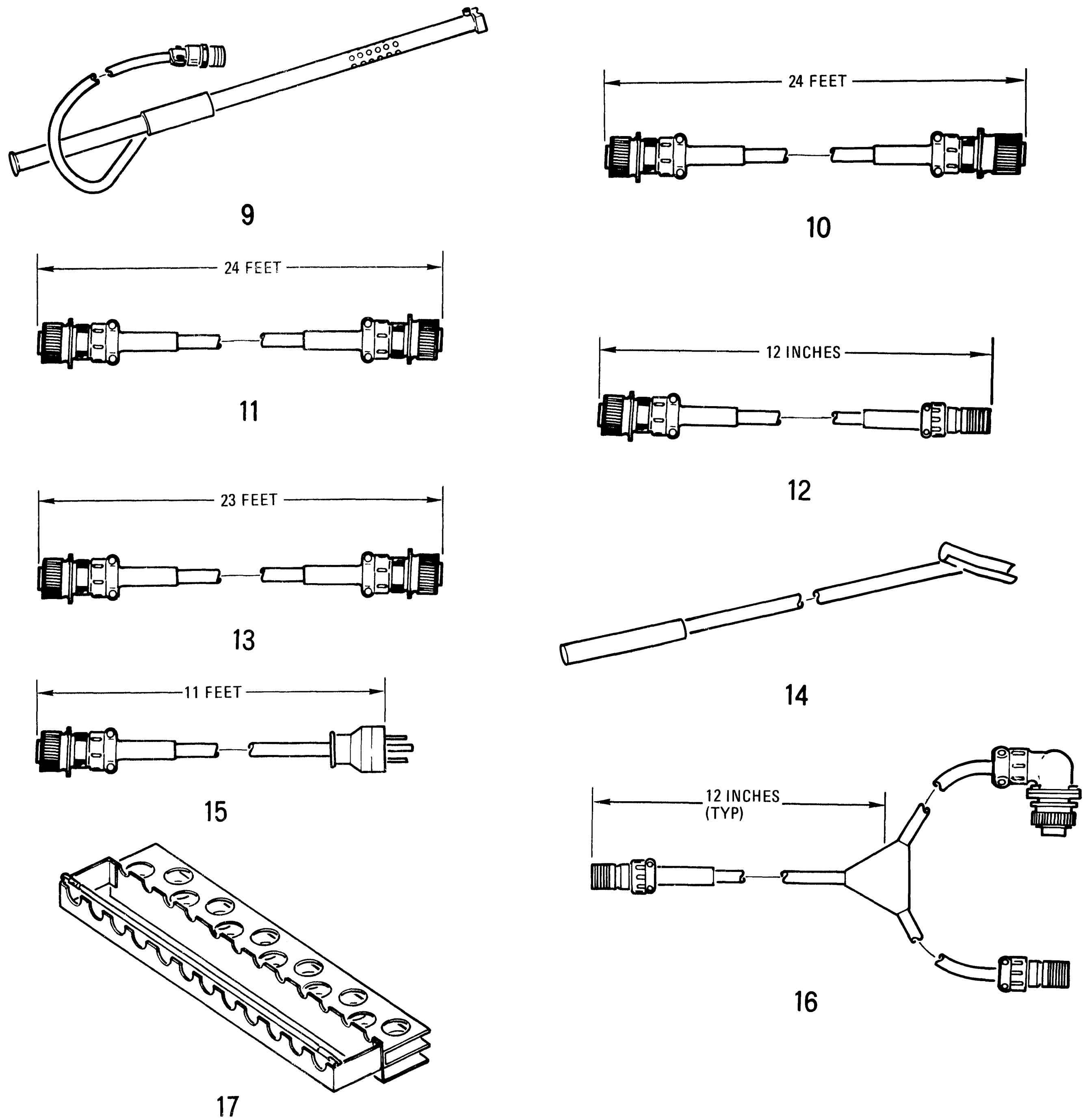


Figure 2-27A. BH112JB-40 Jetcal Analyzer/Trimmer (Sheet 2 of 3)



1	INSTRUMENT CABLE ADAPTER BH10553	9	CONTINUITY PROBE BH3810–40
2	TEMPCAL HEATER PROBE BH1278	10	HEATER CABLE BH405
3	INSULATION ADAPTER BH821	11	CHECK CABLE BH450
4	Y ADAPTER BH10038	12	CHECK CABLE ADAPTER BH5430
5	POWER CABLE INTERCONNECT BH15184A	13	INSTRUMENT CABLE BH485
6	POWER CABLE ADAPTER BH15185A	14	EXTENSION HANDLE BH492B–3
7	JUNCTION BOX BH361–12	15	POWER CABLE BH499A
8	HEATER PROBE BH3801A (12)	16	RPM ADAPTER BH907
		17	HEATER PROBE STORAGE RACK

4C—2—8–(197–3)

Figure 2-27A. BH112JB-40 Jetcal Analyzer/Trimmer (Sheet 3 of 3)

2-80B. BH112JB-40 Jetcal Analyzer/Trimmer Initial Check.

To make sure the analyzer/trimmer is operating properly, an initial operational check of the unit must be made prior to each use. The unit is self contained with the internal capability of simulating an accurate temperature and rpm indication. This capability is used to calibrate and check the accuracy of the unit. See figure 2-27B.

Tools and Equipment.

Jetcal analyzer/trimmer, BH112JB-40
Cable, power, BH499A
Cable, power interconnect, BH15184A
Power source, external electrical 115Vac, 50 to 400 Hz, single phase

Procedure	Normal Indication	Remedy for Abnormal Indication
NOTE The PRESS/EPR portion of the trim module is not used on the F-4 aircraft. Disregard any indications on PRESS/EPR display.		
a. Position switches as follows: (1) On Probe Controller Panel (a) FUNCTION SELECT switch - OFF (2) On Trim Module Panel (a) MASTER POWER switch - off (b) STD DAY switch - OFF		
b. Connect power interconnect cable BH15184A to INTERCONNECT receptacle on probe controller and to POWER INTERCONNECT receptacle on trim module.		
c. Connect power cable BH499A to POWER INPUT receptacle on probe controller and to external electrical power source, 115Vac, 50 to 400 Hz, single phase.		
CAUTION If power is disconnected or turned off, an additional warmup must be performed for accurate unit operation. NOTE A 15 minute warmup time is required to prevent incorrect readings during operation.		
d. On trim module, turn MASTER POWER switch on. Allow 15 minutes warmup time.	POWER ON light comes on.	1. Make sure power cable is connected to external electrical power source. 2. Check lamp. Replace if defective. 3. Check fuse. Replace if defective. 4. Return analyzer/trimmer for repair and/or calibration.

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
e. Adjust DISPLAY intensity as required.		
f. Push DISPLAY PRESS TO TEST switch.	All digits read 8 on trim module displays.	Return analyzer/trimmer for repair and/or calibration.
g. Position TEMPERATURE switch to CAL 600℃.	TEMP℃ display reads 600±2℃.	Perform step i.
h. Position RPM switch to CAL 100% RPM.	% RPM display reads 100±0.1% RPM.	Perform step j.
i. Adjust TEMPERATURE CAL ADJ potentiometer to obtain 600 ±2° on TEMP ℃ display.	TEMP ℃ display reads 600 ±2°.	Return analyzer/trimmer for repair and/or calibration.
j. Adjust RPM CAL ADJ potentiometer to obtain 100 ±0.1 on % RPM display.	% RPM display reads 100 ±0.1 % RPM	Return analyzer/trimmer for repair and/or calibration.

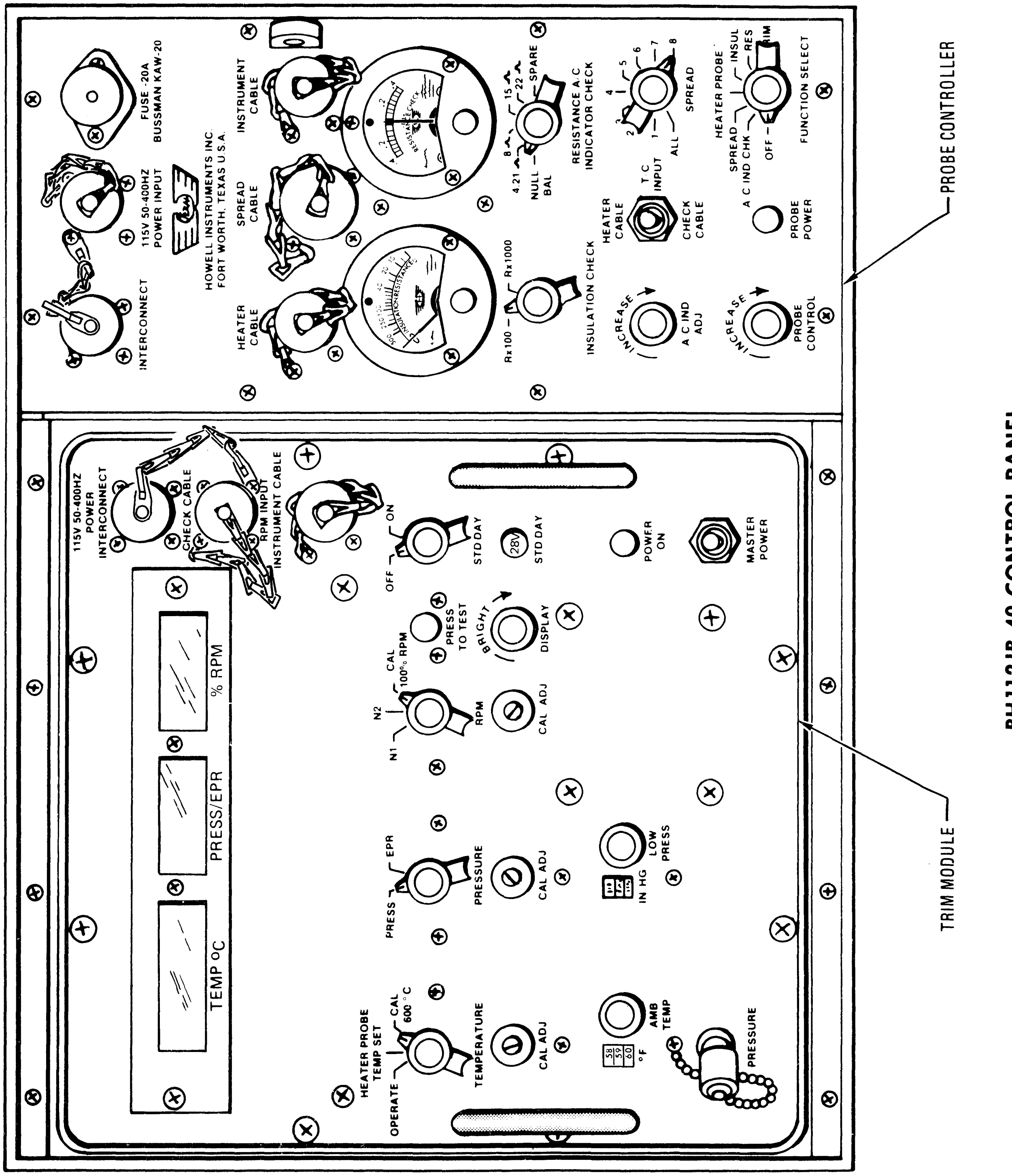
NOTE

As a normal indication, STD DAY light will flash in next step.

A flashing display indicates an improper switch position, also TEMP ℃ display will drift upscale out of range.

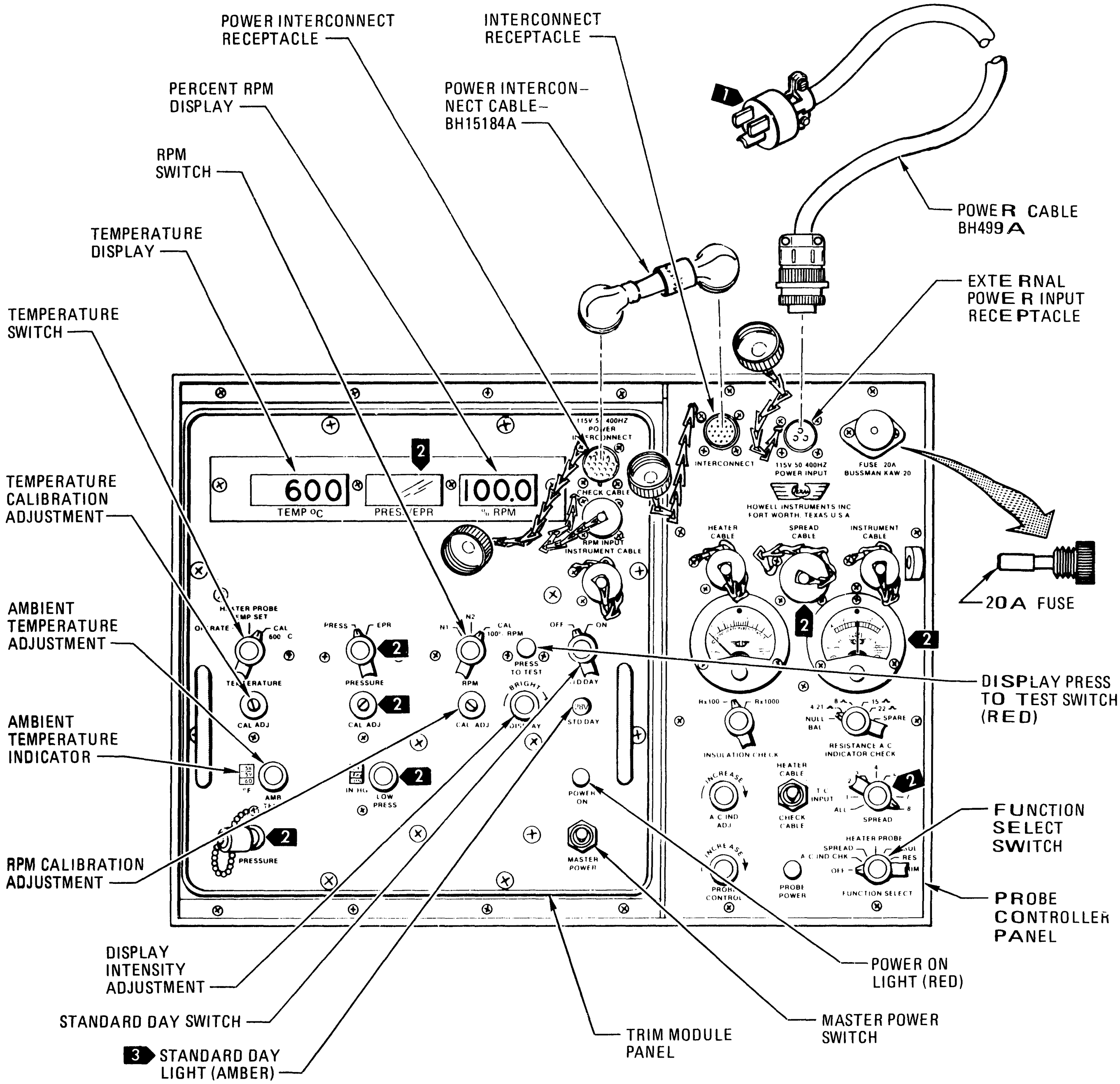
STD DAY lamp is rated at 28Vdc and is not interchangeable with POWER ON or PROBE POWER lamps.

Procedure	Normal Indication	Remedy for Abnormal Indication
m. Position STD DAY switch to ON.	1. STD DAY light flashes.	1. Check and replace lamp if defective. 2. Make sure FUNCTION SELECT switch is OFF.
	2. TEMP ℃ and % RPM display readings do not change more than ±2℃ and ±0.1 % RPM from readings noted in step K.	Repeat steps g through m. If displays are still out of tolerance, return analyzer/trimmer for calibration.
n. Position STD DAY, FUNCTION SELECT switches to OFF and MASTER POWER switch off.	All lights and displays go out.	
o. Proceed to appropriate checkout and/or adjustment procedure.		



4C–2–8–(198–1)

Figure 2-27B. BH112JB-40 Jetcal Analyzer/Trimmer - Initial Check (Sheet 1 of 2)



NOTES

1. POWER SOURCE 115VAC, 50 TO 400HZ, SINGLE PHASE.
2. NOT USED FOR CHECKOUT ON F-4 AIRCRAFT.
3. LAMP OPERATES ON 28VDC, AND IS NOT INTERCHANGABLE WITH OTHER PANEL LAMPS.

4C-2-8-(198-2)

Figure 2-27B. BH112JB-40 Jetcal Analyzer/Trimmer - Initial Check (Sheet 2 of 2)

2-80C. BH112HB-40 Jetcal Analyzer/Trimmer Individual Heater Probe Operational Check.

The proper operation of heater probes is essential for an accurate check of the EGT system. This procedure is both a continuity check and a functional check of the heater probes which must be performed prior to each useage. The type of heater probe and heater probe cable length are critical. The cable lengths must be identical and correct for the particular thermocouple. Combining heater probes of different part numbers and heater probes with unequal cable lengths will result in incorrect readings. See figure 2-27C.

Tools and Equipment.

Jetcal analyzer/trimmer, BH112JB-40
Probes, heater (12), BH3801A-40
Power source, external electrical 115Vac, 50 to 400 Hz, single phase

Procedure	Normal Indication	Remedy for Abnormal Indication
a. Make sure initial check of analyzer/trimmer has been performed. Refer to para 2-80B.		
b. Position controls as follows:		
(1) On Probe Controller Panel		
(a) PROBE CONTROL knob - fully counterclockwise		
(b) FUNCTION SELECT switch - HEATER PROBE		
(c) T/C INPUT switch - HEATER CABLE		
(2) On Trim Module Panel		
(a) TEMPERATURE switch - HEATER PROBE TEMP SET		

NOTE

A 15 minute warmup time is required to prevent incorrect readings during operation.

Procedure	Normal Indication	Remedy for Abnormal Indication
c. On trim module panel, position MASTER POWER switch on. Allow 15 minutes warmup time.	POWER ON light comes on.	1. Make sure power cable is connected to external electrical power source. 2. Check lamp. Replace if defective. 3. Check fuse. Replace if defective. 4. Return analyzer/trimmer for repair and/or calibration.
d. Turn PROBE CONTROL knob clockwise to obtain test temperature of 700°C.	TEMP °C display reads 700°C.	Return analyzer/trimmer for repair and/or calibration.
e. Connect heater probe BH3801A-40 to HEATER CABLE receptacle on probe controller panel.		

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
WARNING To prevent injury to personnel, suspend heater probes away from flamable material. Do not touch hot end of heater probes.		
f. Position TEMPERATURE switch to OPERATE.	TEMP℃ display shows temperature increase and PROBE POWER light stays on steady.	If TEMP℃ display does not show increase in heater probe temperature, replace defective heater probe.
NOTE When probe control overshoots test temperature setting, PROBE POWER light goes off. This indicates power is removed from heater probe and probe is now cooling.		
g. Allow 10 minutes for heater probe temperature to stabilize at test temperature.	PROBE POWER light flashes and TEMP℃ display shows test temperature of 700° ±4℃.	If test temperature cannot be reached, replace heater probe.
h. Position TEMPERATURE switch to HEATER PROBE TEMP SET.		
CAUTION Allow heater probes to cool prior to storage.		
i. Remove heater probe and place in storage rack after cooling.		
j. Repeat steps e thru i for remaining heater probes. Replace defective heater probes.		
k. Position controls as follows:		
(1) On Probe Controller Panel		
(a) PROBE CONTROL knob - fully counterclockwise		
(b) FUNCTION SELECT switch - OFF		
(c) T/C INPUT switch - CHECK CABLE		
(2) On Trim ModulePanel		
(a) TEMPERATURE switch - CAL 600℃.		
(b) MASTER POWER switch - off	All lights and displays go out.	

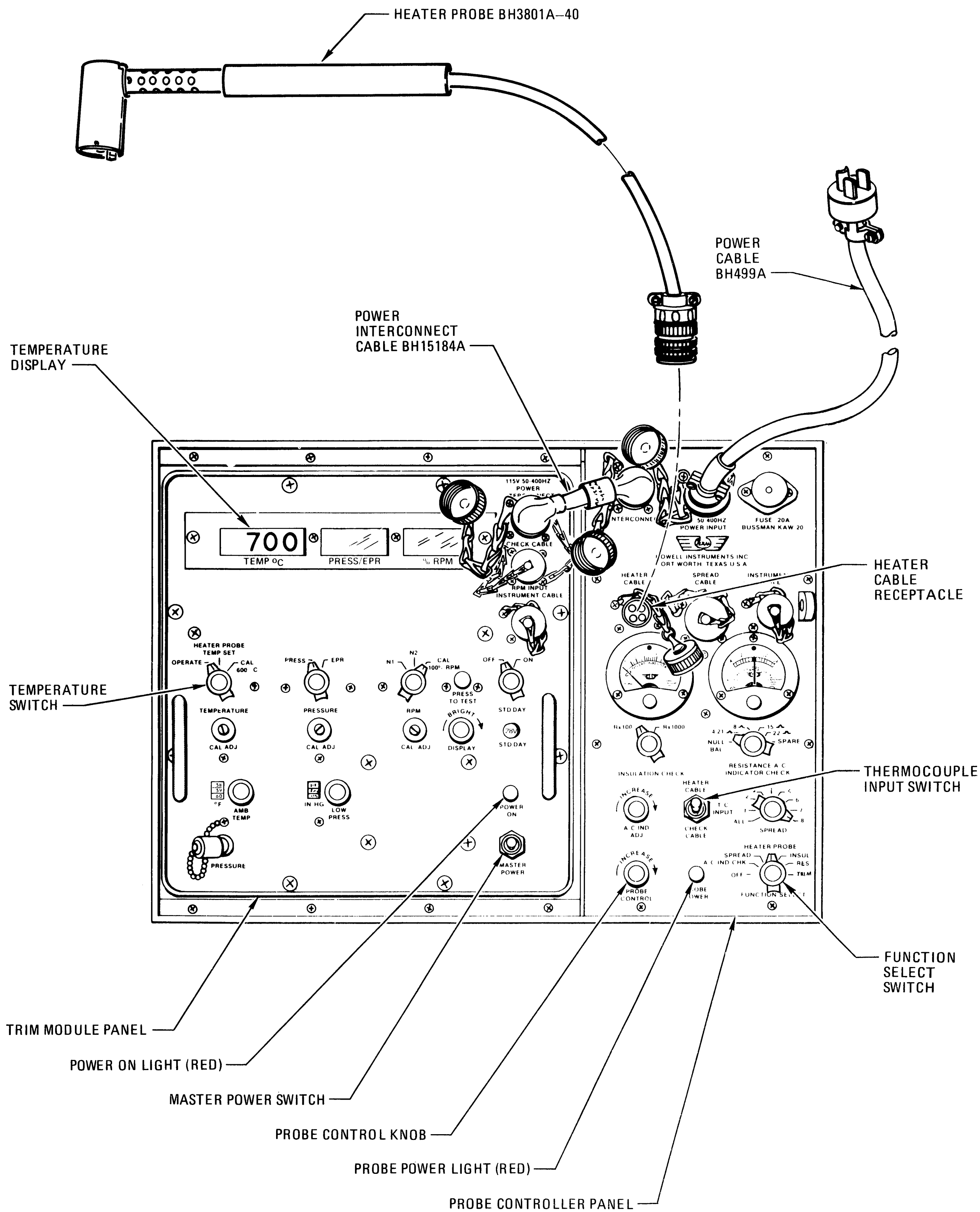


Figure 2-27C. BH112JB-40 Jetcal Analyzer/Trimmer - Individual Heater Probe Operational Check

2-80D. BH112JB-40 Jetcal Analyzer/Trimmer Individual Thermocouple Check.

To ensure the engine thermocouple circuits are operating properly, a check of each thermocouple should be performed. The individual thermocouple check tests both the temperature amplifier circuit and the engine EGT circuit within the thermocouple system. A cold insulation resistance reading is taken first to check the thermocouple system insulation resistance at ambient temperature. Then heat is applied to each thermocouple with the continuity probe and the output checked for both circuits using the analyzer/trimmer. An increase in temperature, noted on the analyzer/trimmer display, indicates the thermocouple and related circuits are operating correctly. See figure 2-27D.

Tools and Equipment.

Jetcal analyzer/trimmer, BH112JB-40
Cable, check, BH450
Cable, instrument, BH485
Adapter, check cable, BH5430
Adapter, insulation check, BH821
Cable, heater, BH405
Probe, continuity, BH3810-40
Handle, extension, BH492B-3
Power source, external electrical, 115Vac, 50 to 400 Hz, single phase

Materials.

Lockwire, MS20995NC20

Manpower Requirements.

Two men required.

Procedure	Normal Indication	Remedy for Abnormal Indication
WARNING To prevent injury to personnel, make sure safety struts are installed on door 81 L and R actuators. Doors will close if electrical power is interrupted with hydraulic power applied.		
a. Make sure safety struts are installed on door 81 L and R actuators. Disconnect actuator from door 81 L or R and open door 82 L if left engine is to be checked.		
b. Remove lockwire and disconnect aircraft EGT indicator connector from engine electrical disconnect bracket. See detail A.		
c. Remove lockwire and disconnect engine thermocouple connector at temperature amplifier. See detail A.		
d. Make sure all other electrical connections in thermocouple system are properly connected.		
e. Make sure initial check of the analyzer/trimmer has been performed. Refer to para 2-80B.		
f. Position controls as follows:		
(1) On Probe Controller Panel		
(a) FUNCTION SELECT switch - IN INSUL		
(b) INSULATION CHECK switch - RX100		
(2) On Trim Module Panel		
(a) MASTER POWER switch - off		

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
g. Connect instrument cable BH485 to INSTRUMENT CABLE receptacle on analyzer/trimmer and to insulation check adapter BH821.		

NOTE

A 15 minute warmup time is required to prevent incorrect readings during operation.

Procedure	Normal Indication	Remedy for Abnormal Indication
h. On trim module, turn MASTER POWER switch to on. Allow 15 munutes warmup time.	POWER ON light comes on.	1. Make sure power cable is connected to external electrical power source. 2. Check lamp. Replace if defective. 3. Check fuse. Replace if defective. 4. Return analyzer/trimmer for repair and/or calibration.
i. Connect alligator clips together.	INSULATION CHECK meter reads 0 ohms.	Return analyzer/trimmer for repair and/or calibration.
j. Using insulation check adapter, measure cold insulation resistance as follows: (1) Pin A to aircraft ground, at engine thermocouple electrical connector (temperature amplifier circuit). See detail A. (2) Pin A to aircraft ground, at engine thermocouple receptacle (electrical disconnect bracket). See detail A. (3) Pin A at thermocouple electrical connector (temperature amplifier circuit) to pin A at thermocouple receptacle (electrical disconnect bracket). See detail A.	INSULATION RESISTANCE meter reads 1250 ohms minimum.	1. Disconnect all electrical connectors and clean contacts in thermocouple system. Refer to TO 2J-J79-46. 2. Reconnect electrical connectors and repeat step. 3. If insulation resistance readings are still less than 1250 ohms, perform thermocouple resistance check. Refer to para 2-80G.
k. Position controls as follows: (1) On Trim Module Panel (a) MASTER POWER switch - off (b) TEMPERATURE switch - CAL 600°C. (2) On Probe Controller Panel (a) T/C INPUT switch - CHECK CABLE (b) PROBE CONTROL knob - full counterclockwise. (c) FUNCTION SELECT switch - OFF	All lights and displays go out.	
l. Remove instrument cable from analyzer/trimmer and insulation check adapter.		

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
m. Connect check cable BH450 to engine thermocouple receptacle on engine electrical disconnect bracket and opposite end of check cable to CHECK CABLE receptacle on trim module panel.		
n. Connect heater cable BH 405 to HEATER CABLE receptacle on probe controller and opposite end to continuity probe BH3810-40.		
o. Attach extension handle BH492B-3 to continuity probe.		

NOTE

A 15 minute warmup time is required to prevent incorrect readings during operation.

Procedure	Normal Indication	Remedy for Abnormal Indication
p. On trim module, turn MASTER POWER switch to on. Allow 15 minutes warmup time.	POWER ON light comes on.	1. Make sure power cable is connected to external electrical power source. 2. Check lamp. Replace if defective. 3. Check fuse. Replace if defective. 4. Return analyzer/trimmer for repair and/or calibration.
q. Position controls as follows: (1) On Probe Controller Panel (a) FUNCTION SELECT switch - HEATER PROBE (b) T/C INPUT switch - HEATER CABLE (2) On Trim Module Panel (a) TEMPERATURE switch - HEATER PROBE TEMP SET		
r. Turn PROBE CONTROL knob clockwise to obtain 700°C.	TEMP °C display reads 700°C.	Return analyzer/trimmer for repair and/or calibration

CAUTION

While continuity probe is heated, do not touch. Probe must be placed away from personnel. Keep away from flammable material.

NOTE

While continuity probe is heating, PROBE POWER light is on steady. The probe control will overshoot test temperature and PROBE POWER light will go out until probe temperature drops and stabilizes at test temperature. When probe terperature stabilizes at test temperature, PROBE POWER light flashes.

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
s. Position TEMPERATURE switch to OPERATE. Allow probe to stabilize at test temperature.	PROBE POWER light flashes and TEMP ℃ display reads 700℃.	1. Make sure heater cable connections are tight. 2. Return analyzer/trimmer for repair and/or calibration.
t. Position T/C INPUT switch to CHECK CABLE.		

CAUTION

Exercise care when entering nozzle assembly to avoid damaging the flaps.

NOTE

Within each of the twelve engine thermocouples are two thermocouple loops, and when heated produce voltage. If minimum clearance does not exist between the loops, incorrect thermocouple voltage could result.

Procedure	Normal Indication	Remedy for Abnormal Indication
u. Make sure minimum clearance of 0.015 inch exists between two inner thermocouple loops. See detail B.		
v. Carefully place continuity probe on one thermocouple and observe TEMP ℃ display. Repeat for each thermocouple. See detail B.	TEMP ℃ display reading increases as each thermocouple is heated.	Perform thermocouple resistance check. Refer to para 2-80E.
w. Disconnect check cable from engine thermocouple receptacle on engine electrical disconnect bracket. See detail A.		
x. Connect check cable adapter BH5430 to temperature amplifier engine thermocouple connector and to check cable. See detail A		
y. Carefully place continuity probe on one thermocouple and observe TEMP ℃ display. Repeat for each thermocouple. See detail B.	TEMP℃ display reading increases as each thermocouple is heated.	Perform thermocouple resistance check. Refer to para 2-80G.
z. Position controls as follows: (1) On Probe Controller Panel (a) PROBE CONTROL knob - full counterclockwise (b) FUNCTION SELECT switch - OFF (2) On Trim Module Panel (a) TEMPERATURE switch - CAL 600°C (b) MASTER POWER switch - off	All lights and displays go out.	
aa. Disconnect power cable from external electrical power source.		

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
CAUTION To prevent damage to equipment, allow continuity probe to cool prior to storing.		
ab. Remove heater cable from continuity probe and analyzer/trimmer, also check cable and adapter from temperature amplifier thermocouple connector and analyzer/trimmer.		
ac. *Connect engine thermocouple connector to temperature amplifier and aircraft EGT indicator connector to engine thermocouple receptacle and lockwire.* See detail A.		
ad. *Start engine and check variable exhaust nozzle and EGT indicator.* Refer to TO 1F-4C-2-8CL-1.		
ae. *Record Jetcal accomplishment on aircraft forms.*		
af. If Jetcal checkout is complete, *connect actuator to door 81L or R and close door 82L if required.*		

NOTES

1. FUNCTION SELECT SWITCH IN INSUL POSITION DURING COLD INSULATION RESISTANCE CHECK ONLY.
2. THE DISTANCE BETWEEN THE THERMOCOUPLE DUAL LOOPS MUST BE 0.015 INCH MINIMUM.

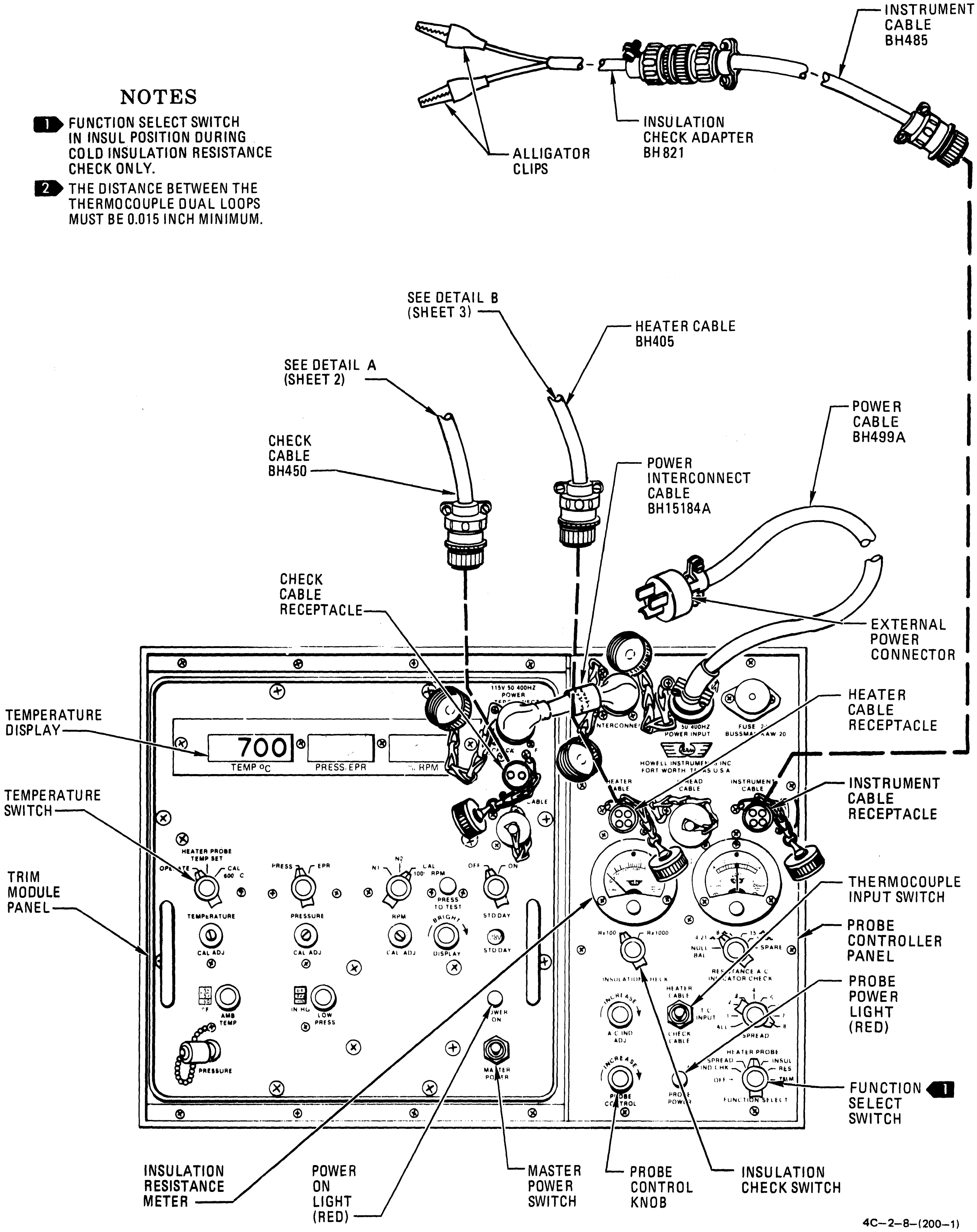


Figure 2-27D. BH112JB-40 Jetcal Analyzer/Trimmer - Individual Thermocouple Check (Sheet 1 of 3)

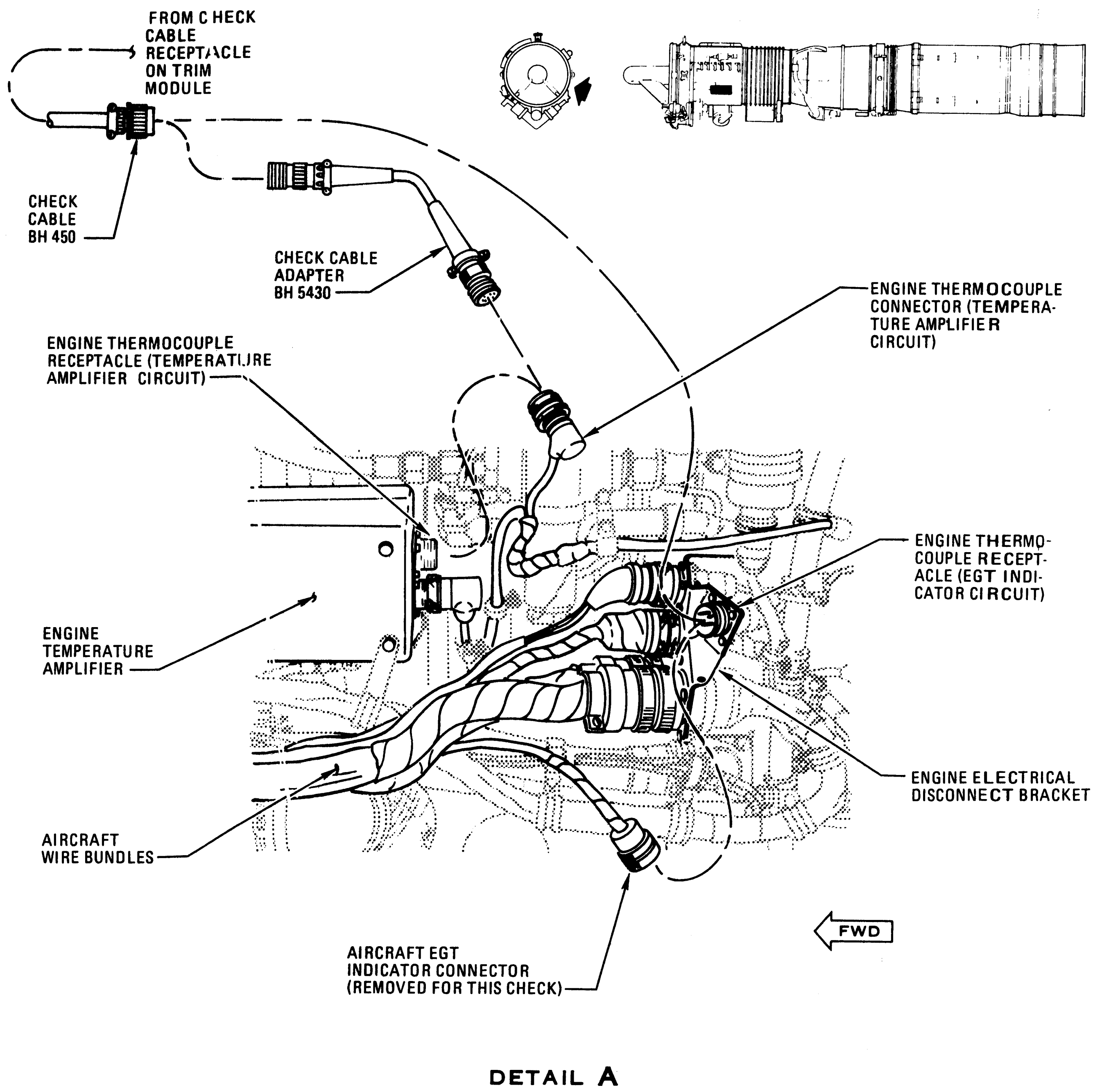


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Figure 2-27D. BH112JB-40 Jetcal Analyzer /Trimmer - Individual Thermocouple Check (Sheet 2 of 3)

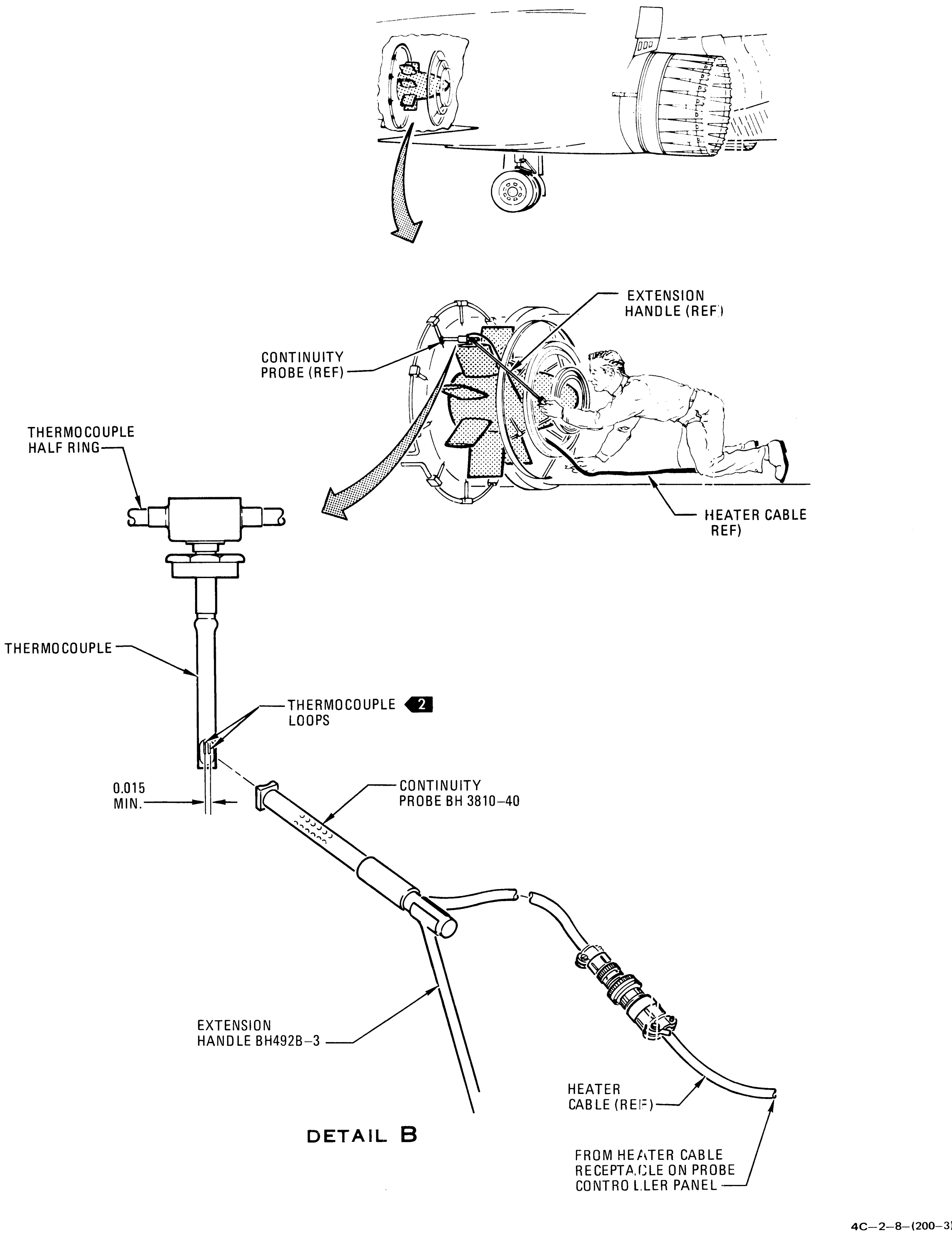


Figure 2-27D. BH112JB-40 Jetcal Analyzer/Trimmer - Individual Thermocouple Check (Sheet 3 of 3)

2-80E. BH112JB-40 Jetcal Analyzer/Trimmer - Thermocouple Harness Check.

The thermocouple harness check tests all engine thermocouples and thermocouple harnesses, which consists of temperature amplifier and EGT indicator circuits. Operation and accuracy, of the thermocouples and their related circuitry is checked by applying controlled heat to the thermocouples and comparing their average output with the applied heat. See figure 2-27E.

Tools and Equipment.

Jetcal analyzer/trimmer, BH112JB-40
Box, Junction, BH361-12
Cable, check, BH450
Adapter, check cable, BH5430
Cable, heater, BH405
Probe, heater, BH3801A-40 (12)
Power source, external electrical 115Vac, 50 to 400 Hz, single phase

Materials.

Lockwire, MS20995NC20

Procedure	Normal Indication	Remedy for Abnormal Indication
WARNING To prevent injury to personnel, make sure safety struts are installed on door 81 L and R actuators. Doors will close if electrical power is interrupted with hydraulic power applied.		
a. Make sure safety struts are installed on door 81 L and R actuators. Disconnect actuator from door 81 L or R and open door 82 L if left engine is to be checked.		
b. Make sure initial check of the analyzer/trimmer has been performed, and all heater probes are operating correctly. Refer to para 2-80B and 2-80C.		
c. Position controls as follows:		
(1) On Probe Controller Panel		
(a) T/C INPUT switch - CHECK CABLE		
(b) PROBE CONTROL knob - full counterclockwise		
(c) FUNCTION SELECT switch - OFF		
(2) On Trim Module Panel		
(a) MASTER POWER switch - off		
(b) TEMPERATURE switch - CAL 600°C		
d. Remove lockwire and disconnect aircraft EGT indicator connector from engine electrical disconnect bracket. See detail A.		
e. Connect check cable BH450 to engine thermocouple receptacle on engine electrical disconnect bracket and opposite end of check cable to CHECK CABLE receptacle on trim module panel.		

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
CAUTION Each type of thermocouple has a specially designed probe. Use only probes designed for thermocouples being tested. Use probes with identical part numbers to prevent incorrect readings. Exercise care when entering nozzle assembly to avoid damaging the flaps.		
f. Carefully place a heater probe BH3801A-40 over each of twelve engine thermocouples. As each probe is placed over thermocouple, connect its cable to junction box BH361-12. Probes must fit firmly and be positioned properly on thermocouples. Recheck after all connections are made. See detail B.		
g. Connect heater cable BH405 to junction box and to HEATER CABLE receptacle on probe controller.		
NOTE A 15 minute warmup time is required to prevent incorrect readings during operation.		
h. On trim module, turn MASTER POWER switch to on. Allow 15 minutes warmup time.	POWER ON light comes on.	1. Make sure power cable is connected to external electrical power source. 2. Check lamp. Replace if defective. 3. Check fuse. Replace if defective. 4. Return analyzer/trimmer for repair and/or calibration.
NOTE If check is to be made during cold or windy weather, place a cover over exhaust nozzle.		
i. Position controls as follows: (1) On Probe Controller Panel (a) FUNCTION SELECT switch - HEATER PROBE (b) T/C INPUT switch - HEATER CABLE (2) On Trim Module Panel (a) TEMPERATURE switch - HEATER PROBE TEMP SET		

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
j. Turn PROBE CONTROL knob clockwise to obtain 625°C.	TEMP°C display reads 625°C.	Return analyzer/trimmer for repair and/or calibration.

CAUTION

When replacing a defective heater probe, TEMPTERTURE switch must be in HEATER PROBE TEMP SET position to remove power from probes. To prevent overheating of hot probes after probe is replaced, all probes must cool to near ambient temperature before applying power and reheating.

NOTE

While thermocouple heater probes are heating, PROBE POWER light is on steady. The probe control will overshoot test temperature and PROBE POWER light will go out until probe temperature drops and stabilizes at test temperature. When probe temperature stabilizes at test temperature, PROBE POWER light flashes.

k. Position TEMPERATURE switch to OPERATE. Allow thermocouples to heat soak for 10 minutes at 625°C test temperature.	PROBE POWER light flashes and TEMP°C display reads 625°C.	1. Make sure heater cable and heater probe connections are tight. 2. Return analyzer/trimmer for repair and/or calibration.
1. Record temperature of TEMP°C display.		
m. Position T/C INPUT switch to CHECK CABLE.	TEMP°C display reads within 10°C of temperature recorded in step 1.	If temperature exceed 10°C difference, perform thermocouple resistance check. Refer to para 2-80G.

NOTE

The following step checks thermocouples for an open circuit at high temperature.

n. Remove a heater probe from thermocouple and check for temperature decrease on TEMP °C display. Reinstall each thermocouple.	TEMP°C display reading decreases.	If TEMP°C display reading does not decrease, the thermocouple has an open circuit; replace defective thermocouple half ring. Refer to TO 2J-J79-46.
o. Disconnect check cable from engine thermocouple receptacle on engine electrical disconnect bracket. See detail A.		
p. Remove lockwire and disconnect engine thermocouple connector at temperature amplifier. See detail A.		

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
q. Connect check cable adapter BH5430 to temperature amplifier engine thermocouple connector and to check cable. See detail A.		
r. Read temperature of engine thermocouples on TEMP°C display.	TEMP°C display reads within 10°C of temperature recorded in step 1.	If temperature exceeds 10°C difference, perform thermocouple resistance check. Refer to para 2-80G.

NOTE

The following step checks thermocouples for an open circuit at high temperature.

Procedure	Normal Indication	Remedy for Abnormal Indication
s. Remove a heater probe from thermocouple and check for temperature decrease on TEMP°C display. Reinstall heater probe. Repeat for each thermocouple.	TEMP°C display reading decreases.	If TEMP°C display reading does not decrease, the thermocouple has an open circuit. Replace defective thermocouple half ring. Refer to TO 2J-J79-46.
t. Position controls as follows:		
(1) On Probe Controller Panel		
(a) PROBE CONTROL knob - full counterclockwise		
(b) FUNCTION SELECT switch - OFF		
(2) On Trim Module Panel		
(a) TEMPERATURE switch - CAL 600°C.		
(b) MASTER POWER switch - off		
u. Disconnect power cable from external electrical power source.		

CAUTION

To prevent damage to equipment, allow heater probes to cool prior to storing.

Procedure	Normal Indication	Remedy for Abnormal Indication
v. *Remove heater probes and cable from engine and analyzer trimmer.*		
w. *Connect engine thermocouple connector to temperature amplifier and aircraft EGT indicator connector to engine thermocouple receptacle and lockwire. See detail A.*		
x. Start engine and check variable exhaust nozzle and EGT indicator. Refer to TO 1F-4C-2-8CL-1.		
y. *Record Jetcal accomplishment on aircraft forms.*		
z. If Jetcal checkout is complete, *connect actuators to door 81L or R and close door 82L if required.*		

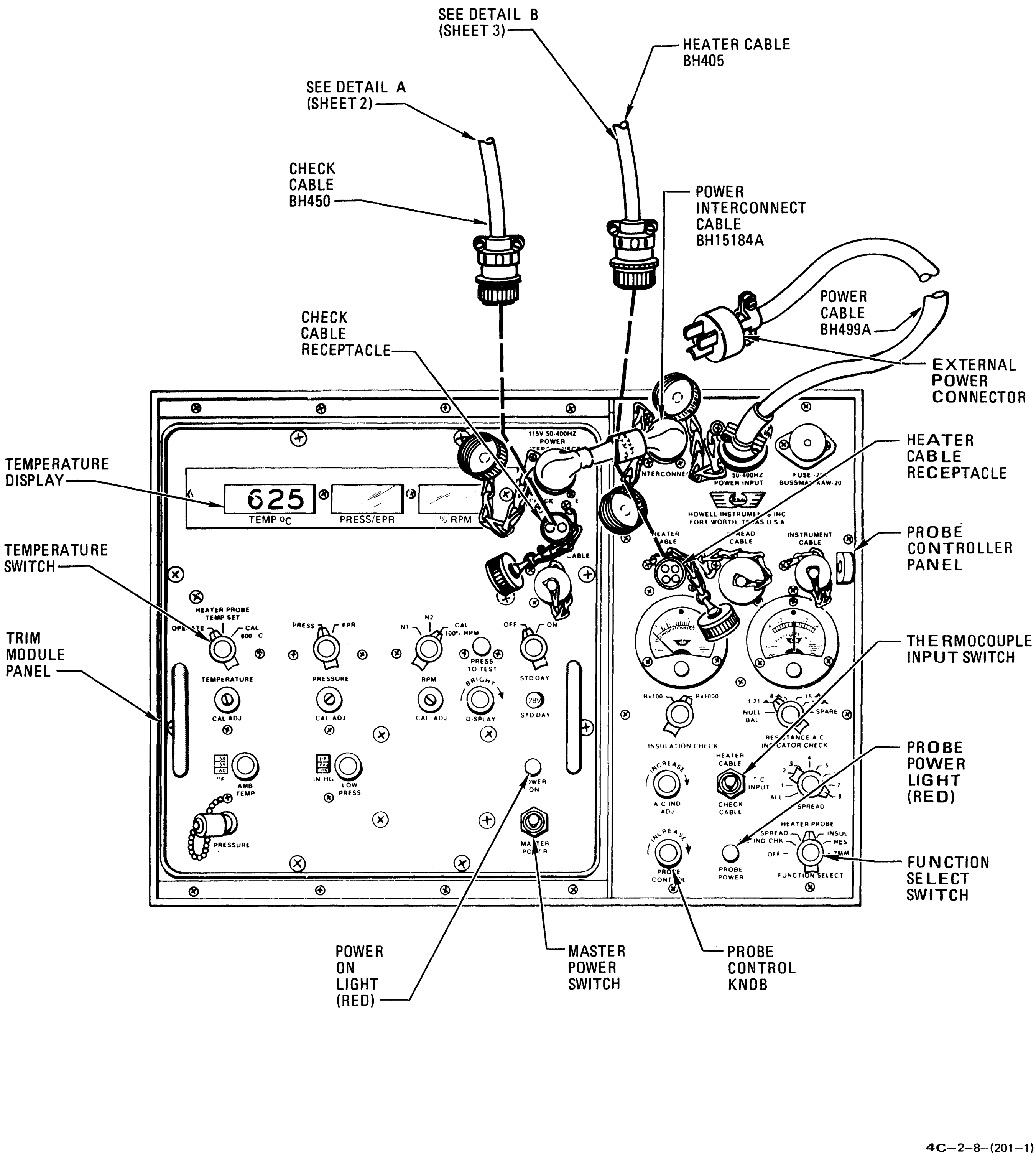
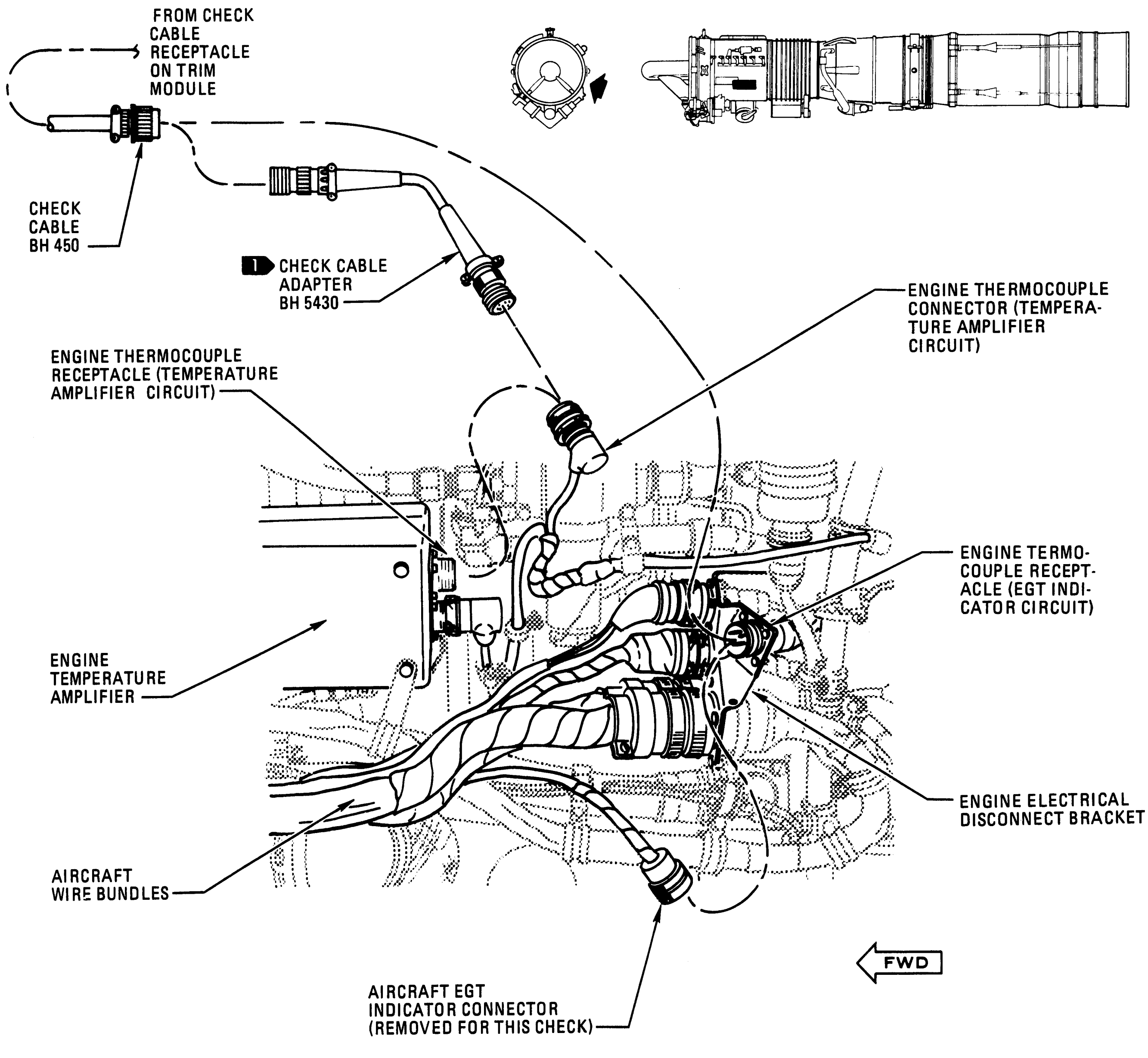


Figure 2-27E. BH112JB-40 Jetcal Analyzer/Trimmer Thermocouple Harness Check (Sheet 1 of 3)



DETAIL A

NOTE

1 CHECK CABLE ADAPTER BH5430 CONNECTS ENGINE THERMOCOUPLE CONNECTOR TO ANALYZER/TRIMMER CHECK CABLE BH 450 WHEN CHECKING TEMPERATURE AMPLIFIER CIRCUIT.

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Figure 2-27E. BH112JB-40 Jetcal Analyzer/Trimmer Thermocouple Harness Check (Sheet 2 of 3)

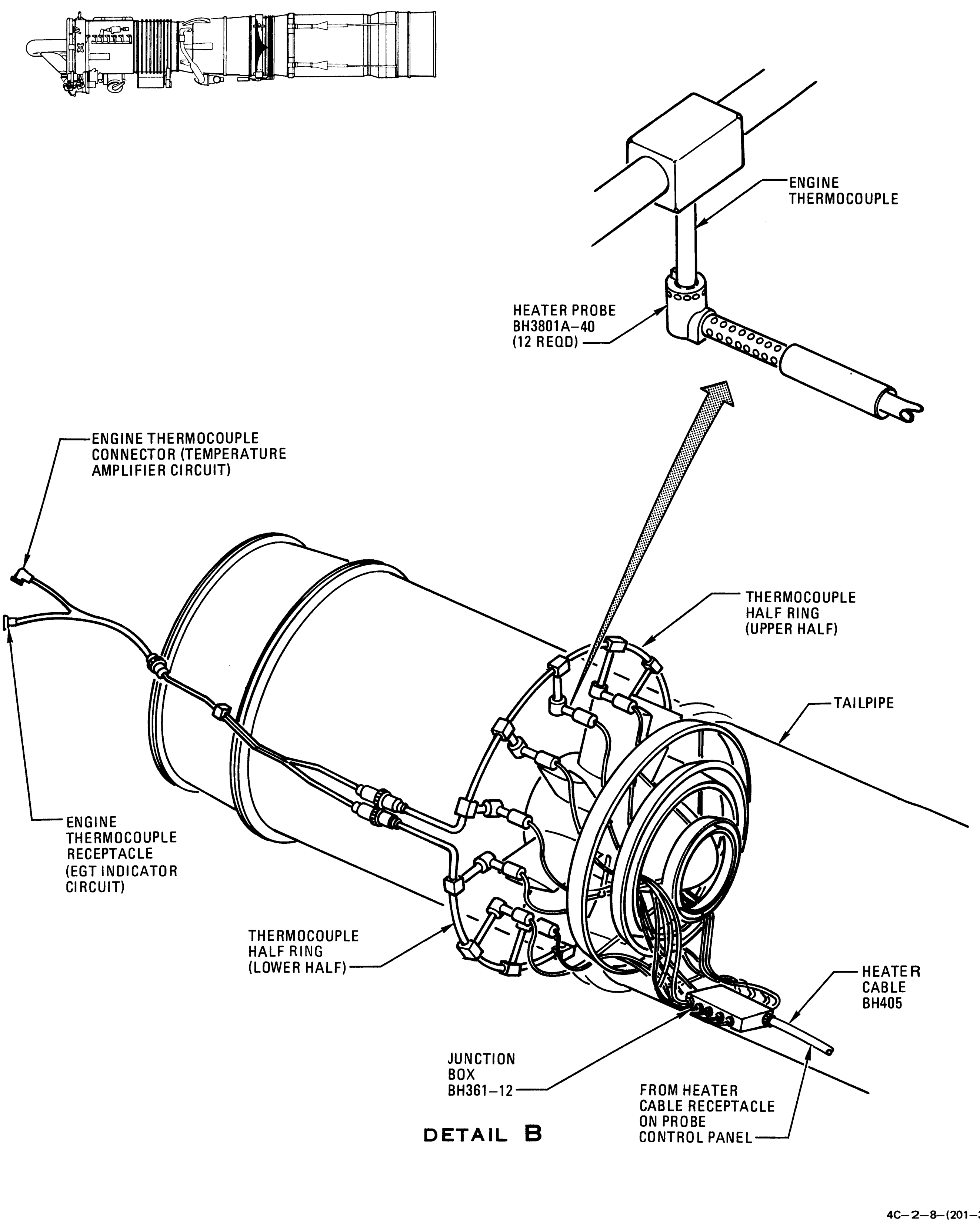


Figure 2-27E. BH112JB-40 Jetcal Analyzer/Trimmer Thermocouple Harness Check (Sheet 3 of 3)

2-80F. BH112JB-40 Jetcal Analyzer/Trimmer - Hot Insulation Resistance Check.

To make sure the thermocouple harness circuit is operating properly a hot insulation resistance check should be performed. A breakdown of the insulating material between the conductor and aircraft ground will affect engine operation and EGT indicator reading. In this check, a controlled heat is applied to the thermocouples by heater probes. While the thermocouples are at operating temperature, the resistance between the thermocouple conductors and aircraft ground is measured then followed by a check of the resistance between thermocouple conductors. See figure 2-27E.

Tools and Equipment.

Jetcal analyzer/trimmer, BH112JB-40
Cable, heater, BH405
Box, junction, BH361-12
Probe, heater, BH3801A-40
Multimeter Power source, external electrical 115Vac, 50 to 400 Hz, single phase

Materials.

Lockwire, MS20995NC20

Procedure	Normal Indication	Remedy for Abnormal Indication
WARNING To prevent injury to personnel, make sure safety struts are installed on doors 81 L and R actuators. Doors will close if electrical power is interrupted with hydraulic power applied.		
a. Make sure safety struts are installed on doors 81 L and R actuators. Disconnect actuator from doors 81 L or R and open door 82 L if left engine is to be checked.		
b. Make sure initial check of the analyzer/trimmer has been performed and all heater probes are operating properly. Refer to para 2-80B and 2-80C.		
c. Position controls as follows:		
(1) On Probe Controller Panel		
(a) T/C INPUT switch - CHECK CABLE		
(b) PROBE CONTROL knob - full counterclockwise		
(c) FUNCTION SELECT switch -OFF		
(2) On Trim Module Panel		
(a) MASTER POWER switch - off		
(b) TEMPERATURE switch - HEATER PROBE TEMP SET		
d. Remove lockwire and disconnect aircraft EGT indicator connector from engine electrical disconnect bracket. See detail A.		
e. Remove lockwire and disconnect engine thermocouple connector from engine thermocouple receptacle on temperature amplifier. See detail A.		

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
CAUTION Each type of thermocouple has a specially designed probe. Use only probes designed for thermocouples being tested. Use probes with identical part numbers to prevent incorrect readings. Exercise care when entering nozzle assembly to avoid damaging the flaps.		
f. Carefully place a heater probe BH3801A-40 over each of twelve engine thermocouples. As each probe is placed over thermocouple, connect its cable to junction box BH361-12. Probes must fit firmly and be positioned properly on thermocouples. Recheck after all connections are made. See detail B.		
g. Connect heater cable BH405 to junction box and to HEATER CABLE receptacle on probe controller.		
NOTE A 15 minute warmup time is required to prevent incorrect readings during operation.		
h. On trim module, turn MASTER POWER switch on. Allow 15 minutes warmup time.	POWER ON light comes on.	1. Make sure power cable is connected to external electrical power source. 2. Check lamp. Replace if defective. 3. Check fuse. Replace if defective. 4. Return analyzer/trimmer for repair and/or calibration.
i. On probe controller panel, position FUNCTION SELECT switch to HEATER PROBE and T/C INPUT switch to HEATER CABLE.		
j. Turn PROBE CONTROL knob clockwise to obtain 625℃.	TEMP℃ display reads 625℃.	Return analyzer/trimmer for repair and/or calibration.
CAUTION When replacing a defective heater probe, TEMPERATURE switch must be in HEATER PROBE TEMP SET position to remove power from probes. To prevent overheating of hot probes after probe is replaced, all probes must cool to near ambient temperature before applying power and reheating. NOTE While thermocouple heater probes are heating, PROBE POWER light is on steady. The probe control will overshoot test temperature and PROBE POWER light will go out until probe temperature drops and stabilizes at test temperature. When probe temperature stabilizes at test temperature, PROBE POWER light flashes.		

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
k. Position TEMPERATURE switch to OPERATE. Allow thermocouples to heat soak for 10 minutes at 625°C test temperature.	1. PROBE POWER light flashes and TEMP°C display reads 625°C.	1. Make sure heater cable and heater probe connections are tight. 2. Return analyzer/trimmer for repair and/or calibration.
l. Using multimeter, measure resistance between pin A of engine thermocouple connector (temperature amplifier circuit) and ground. See detail A.	250 ohms minimum.	1. Disconnect all connectors and clean contacts in thermocouple system. Refer to TO 2J-J79-46. Reconnect connectors and repeat step. 2. Perform thermocouple resistance check. Refer to para 2-80G.
m. Measure resistance between pin A of engine thermocouple receptacle (EGT indicator circuit) and ground. See detail A.	250 ohms minimum.	1. Disconnect all connectors and clean contacts in thermocouple system. Refer to TO 2J-J79-46. Reconnect connectors and repeat step. 2. Perform thermocouple resistance check. Refer to para 2-80G.
n. Measure resistance between pin A at engine thermocouple connector (temperature amplifier circuit) and pin A at engine thermocouple receptacle (EGT indicator circuit). See detail A.	250 ohms minimum	1. Disconnect all connectors and clean contacts in thermocouple system. Refer to TO 2J-J79-46. Reconnect connectors and repeat step. 2. Perform thermocouple resistance check. Refer to para 2-80G.
o. Position controls as follows: (1) On Probe Controller Panel (a) PROBE CONTROL knob-full counterclockwise (b) FUNCTION SELECT switch-OFF (c) T/C INPUT switch-CHECK CABLE (2) On Trim Module Panel (a) TEMPERATURE switch-CAL 600°C (b) MASTER POWER switch-off		

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
CAUTION To prevent damage to equipment, allow heater probes to cool prior to storage.		
p. Remove heater probes and cables from engine and analyzer/trimmer.		
q. *Connect engine thermocouple connector to temperature amplifier and aircraft EGT indicator connector to engine thermocouple receptacle and lockwire.*		
r. *Record Jetcal accomplishment on aircraft forms.*		
s. If Jetcal checkout is complete, *connect actuator to doors 81L or R and close door 82L if required.*		

2-80G. **BH112JB-40 Jetcal Analyzer/Trimmer - Thermocouple Resistance Check.**

This procedure checks the resistance of engine thermocouple circuit wiring in the half rings, rigid lead, and flexible lead. A multimeter or wheatstone bridge is used to accurately measure resistance between the wires in a segment and between the wires and ground. A final resistance check is performed using the Jetcal analyzer/trimmer to heat thermocouples to operating temperature for a check of high resistance and shorts to ground. See figure 2-27F.

Tools and Equipment.

Jetcal analyzer/trimmer BH112JB-40
Box, junction BH361-12
Cable, heater BH405
Probe, heater (12) BH3801A-40
Multimeter
Power source, external electrical, 115Vac, 50 to 400 Hz, single phase

Materials.

Lockwire, MS20995NC20
Lockwire, MS20995NC32

Procedure	Normal Indication	Remedy for Abnormal Indication
WARNING To prevent injury to personnel, make sure safety struts are installed on door 81 L and R actuators. Doors will close if electrical power is interrupted with hydraulic power applied.		
a. Make sure safety struts are installed on door 81 L and R actuators. Disconnect actuator on doors 81 L or R. Open doors 82 L and 83 L or 82 R and 83 R.		
b. Remove lockwire and retaining clamps and disconnect the following:		
(1) Electrical connector (7) from receptacle (5).		
(2) Electrical connector (8) from receptacle (6).		
(3) Electrical connector (4) from receptacle (3).		
(4) Aircraft EGT indicator electrical connector from receptacle (2) on engine electrical disconnect bracket.		
(5) Electrical connector (1) from engine thermocouple receptacle on temperature amplifier.		
c. Using multimeter, at receptacle (3) measure resistance between each pin and aircraft ground.	Resistance: 100,00 ohms minimum.	Replace defective flexible lead.
d. At receptacle (3), measure resistance between each pin and every other pin.	Resistance: 100,00 ohms minimum.	Replace defective flexible lead.

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
CAUTION To prevent damage to electrical disconnects, resistance measurements must be made utilizing a slave connector, pins or probe of correct size.		
e. Measure resistance between pins A and B on receptacle (3) with pins A and B jumpered on electrical connector (1). Gently wiggle slave connector or pins while removing. Note meter reading.	Resistance: 1 ohm maximum with no erratic meter deflection or loss of continuity.	Replace defective flexible lead.
CAUTION To prevent damage to electrical disconnects, resistance measurements must be made utilizing a slave connector, pins or probe of correct size.		
f. Measure resistance between pins C and D on receptacle (3) with pins A and B jumpered on receptacle (2). Gently wiggle slave connector or pins while removing. Note meter reading.	Resistance: 1 ohm maximum with no erratic meter deflection or loss of continuity.	Replace defective flexible lead.
g. At electrical connector (4), measure resistance between each pin and aircraft ground.	Resistance: 100,00 ohms minimum.	Replace defective rigid lead.
h. At electrical connector (4), measure resistance between each pin and every other pin.	Resistance: 50,000 ohms minimum.	Replace defective rigid lead.
CAUTION To prevent damage to electrical disconnects, resistance measurements must be made utilizing a slave connector, pins or probe of correct size.		
i. On electrical connector (4), jumper pin A to pin B and pin C to pin D. Measure resistance at receptacle (5) between pins A and B then pins C and D. Gently wiggle slave connector or pins while removing. Note meter reading.	Resistance: 1 ohm maximum with no erratic meter deflection or loss of continuity.	Replace defective rigid lead.
CAUTION To prevent damage to electrical disconnects, resistance measurements must be made utilizing a slave connector, pins or probe of correct size.		
j. On electrical connector (4), jumper pin A to pin B and pin C to pin D. Measure resistance at receptacle (6) between pins A and B then pins C and D. Gently wiggle slave connector or pins while removing. Note meter reading.	Resistance: 1 ohm maximum with no erratic meter deflection or loss of continuity.	Replace defective rigid lead.
k. On electrical connector (7), measure resistance between each pin and aircraft ground.	Resistance: 2500 ohms minimum.	Replace thermocouple half ring. Refer to TO 2J-J79-46.

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
l. On electrical connector (7), measure resistance between pins A and C then pins B and D.	Resistance: 2500 ohms minimum.	Replace thermocouple half ring. Refer to TO 2J-J79-46.

CAUTION

To prevent damage to electrical disconnects, resistance measurements must be made utilizing a slave connector, pins or probe of correct size.

Procedure	Normal Indication	Remedy for Abnormal Indication
m. On electrical connector (7), measure resistance between pins A and B then pins C and D. Gently wiggle slave connector or pins while removing. Note meter reading.	Resistance: 1.76 to 2.16 ohms with no erratic meter deflection or loss of continuity.	Replace thermocouple half ring. Refer to TO 2J-J79-46.
n. Make sure initial check of the analyzer/trimmer has been performed, and all heater probes are operating correctly. Refer to para 2-80B and 2-80C.		
o. Position controls as follows:		
(1) On probe Controller Panel		
(a) T/C INPUT switch - CHECK CABLE		
(b) PROBE CONTROL knob - full counterclockwise.		
(c) FUNCTION SELECT switch - OFF		
(2) On Trim Module Panel		
(a) MASTER POWER switch - off		
(b) TEMPERATURE switch - CAL 600°C		

CAUTION

Each type of thermocouple has a specially designed probe. Use only probes designed for thermocouples being tested. Use probes with identical part numbers to prevent incorrect readings.

Exercise care when entering nozzle assembly to avoid damaging the flaps.

Procedure	Normal Indication	Remedy for Abnormal Indication
p. Carefully place a heater probe BH3801A-40 over each of twelve engine thermocouples. As each probe is placed over thermocouple, connect its cable to junction box BH361-12. Probes must fit firmly and be positioned properly on thermocouples. Recheck after all connections are made. See fig 2-27E, detail B.		

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
q. Connect heater cable BH405 to junction box and to HEATER CABLE receptacle on probe controller.		

NOTE

A 15 minute warmup time is required to prevent incorrect readings during operation.

Procedure	Normal Indication	Remedy for Abnormal Indication
r. On trim module, turn MASTER POWER switch to on. Allow 15 minutes warmup time.	POWER ON light comes on.	1. Make sure power cable is connected to external electrical power source. 2. Check lamp. Replace if defective. 3. Check fuse. Replace if defective. 4. Return analyzer/trimmer for repair and/or calibration.

NOTE

If check is to be made during cold or windy weather, place a cover over exhaust nozzle.

Procedure	Normal Indication	Remedy for Abnormal Indication
s. Position controls as follows: (1) On Probe Controller Panel (a) FUNCTION SELECT switch - HEATER PROBE (b) T/C INPUT switch - HEATER CABLE (2) On Trim Module Panel (a) TEMPERATURE switch - HEATER PROBE TEMP SET		
t. Turn PROBE CONTROL knob clockwise to obtain 600°C	TEMP °C display reads 600°C.	Return analyzer/trimmer for repair and/or calibration.

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
CAUTION When replacing a defective heater probe, TEMPERATURE switch must be in HEATER PROBE TEMP SET position to remove power from probes. To prevent overheating of hot probes after probe is replaced, all probes must cool to near ambient temperature before applying power and reheating. NOTE While thermocouple heater probes are heating, PROBE POWER light is on steady. The probe control will overshoot test temperature and PROBE POWER light will go out until probe temperature drops and stabilizes at test temperature. When probe temperature stabilizes at test temperature, PROBE POWER light flashes.		
u. Position TEMPERATURE switch to OPERATE. Allow thermocouples to heat soak for 10 minutes at 600°C.	PROBE POWER light flashes and TEMP°C display reads 600°C.	1. Make sure heater cable and heater probe connections are tight. 2. Return analyzer/trimmer for repair and/or calibration.
v. On electrical connector (7), measure resistance between each pin and aircraft ground.	Resistance: 500 ohms minimum.	Replace thermocouple half ring. Refer to TO 2J-J79-46.
w. On electrical connector (7), measure resistance from pins A or B to pins C or D.	Resistance: 500 ohms minimum.	Replace thermocouple half ring. Refer to TO 2J-J79-46.
x. On electrical connector (8), measure resistance between each pin and aircraft ground.	Resistance: 500 ohms minimum.	Replace thermocouple half ring. Refer to TO 2J-J79-46.
y. On electrical connector (8), measure from pins A or B to pins C or D.	Resistance: 500 ohms minimum.	Replace thermocouple half ring. Refer to TO 2J-J79-46.
z. Position controls as follows: (1) On Probe Controller Panel (a) PROBE CONTROL knob - full counterclockwise (b) FUNCTION SELECT switch - OFF (2) On Trim Module Panel (a) TEMPERATURE switch - CAL 600°C (b) MASTER POWER switch - off		
aa. Disconnect power cable from external electrical power source.		

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
CAUTION To prevent damage to equipment, allow heater probes to cool prior to storage.		
ab. *Remove heater probes and cable from engine and analyzer/trimmer.*		
ac. Connect the following fingertight and lockwire:		
(1) *Connector (7) to receptacle (5) using MS20995NC32.*		
(2) *Connector (8) to receptacle (6) using MS20995NC32.*		
(3) *Connector (4) to receptacle (3) using MS20995NC32.*		
(4) *Aircraft EGT indicator connector to receptacle (2) using MS20995NC20.*		
(5) *Connector (1) to temperature amplifier receptacle using MS20995NC20.*		
ad. Install retaining clamps.		
ae. Start engine and check variable nozzle and EGT indicator. Refer to TO 1F-4C-2-8CL-1.		
af. Shut down engine. Refer to TO 1F-4C-2-8CL-1.		
ag. *Close doors 82L and 83L or 82R and 83R. Connect rotary switch and actuator to doors 81L or R.*		
ah. *Record Jetcal accomplishment on aircraft form.*		

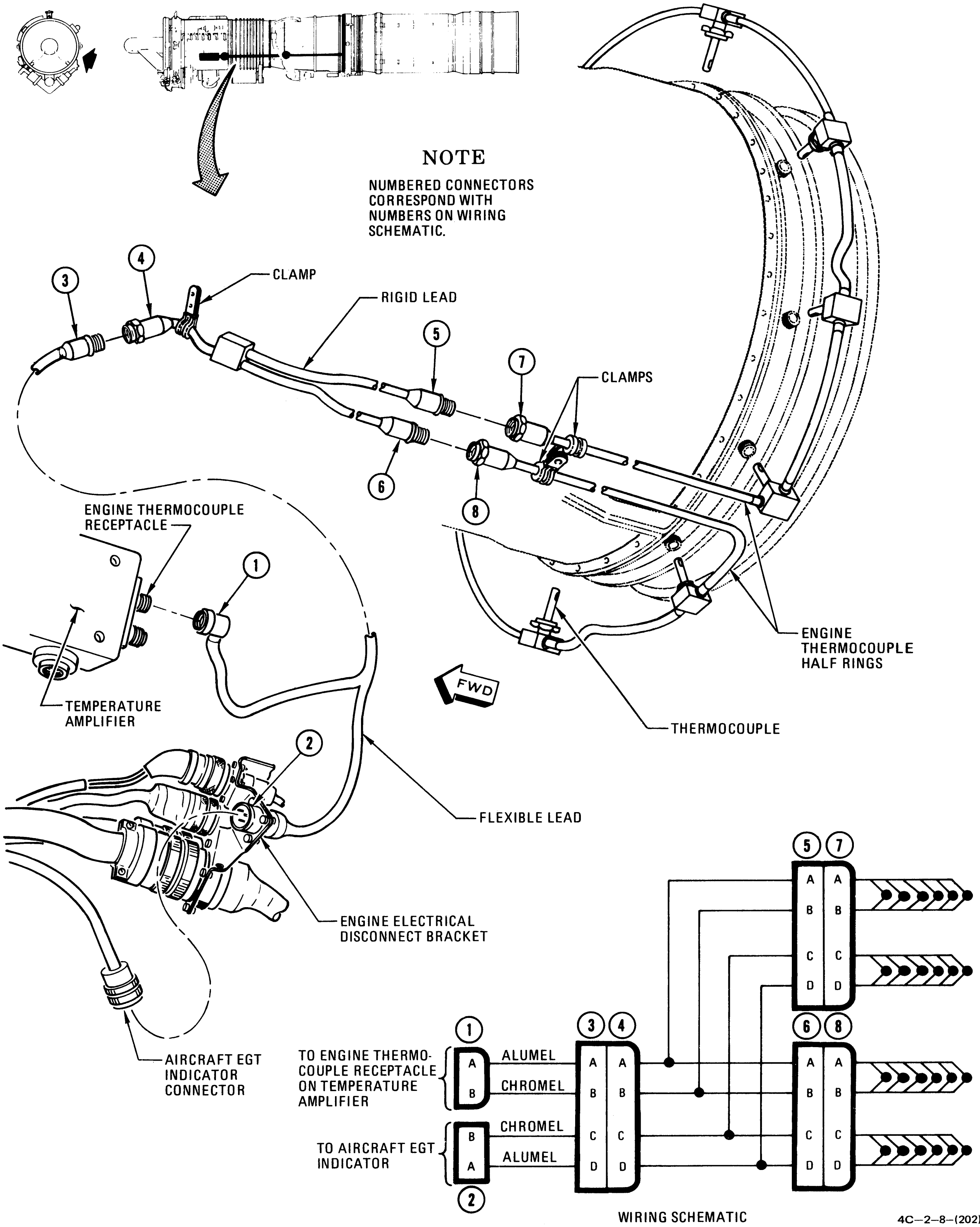


Figure 2-27F. BH112JB-40 Jetcal Analyzer/Trimmer - Thermocouple Resistance Check

2-80H BH112JB-40 Jetcal Analyzer/Trimmer - Exhaust Gas Temperature Indicator Check.

A comparison of aircraft indicator reading and analyzer/trimmer termperature display reading is used to check the EGT indicating system for accuracy. Any difference in the readings is the error of the EGT indicating system. See figure 2-27G.

Tools and Equipment.

Jetcal analyzer/trimmer, BH112JB-40
Cable, adapter, instrument, BH10553
Cable, instrument, BH485
Power source, external electrical, 115Vac 50 to 400Hz, single phase
Power source, aircraft, external electrical

Materials.

Lockwire, MS20995NC20

Manpower Requirement.

Two men required.

Procedure	Normal Indication	Remedy for Abnormal Indication
WARNING To prevent injury to personnel, make sure safety struts are installed on door 81L and R actuators. Doors will close if electrical power is interrupted with hydraulic power applied.		
a. Make sure safety struts are installed on door 81L and R actuators. Disconnect actuator from door 81L or R and open door 82L if left engine is to be checked.		
b. Make sure initial check of analyzer/trimmer has been performed. Refer to para 2-80B.		
c. Position controls as follows:		
(1) On Probe Controller Panel		
(a) FUNCTION SELECT switch - A/C IND CK		
(b) RESISTANCE & A/C INDICATOR CHECK switch - NULL BAL		
(c) A/C IND ADJ knob - full counterclockwise		
(2) On Trim Module Panel		
(a) MASTER POWER switch - off		
(b) TEMPERATURE switch - OPERATE.		
d. At engine electrical disconnect, remove lockwire and disconnect aircraft EGT indicator connector.		
e. Connect one end of instrument cable adapter BH10553 to aircraft EGT indicator connector and connect other end to instrument cable BH485.		
f. On trim module panel, connect instrument cable BH485 to INSTRUMENT CABLE receptacle.		

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
NOTE A 15 minute warmup time is required to prevent incorrect readings during operation.		
g. On trim module panel, position MASTER POWER switch to on. Allow 15 minutes warm-up time.	POWER ON light comes on.	1. Make sure power cable is connected to external electrical power source. 2. Check lamp. Replace if defective. 3. Check fuse. Replace if defective. 4. Return analyzer/trimmer for repair and/or calibration.
h. Apply external electrical power to aircraft.		
i. Adjust A/C IND ADJ knob to obtain test temperature of 625°C.	TEMP °C display reads 625°C.	Return analyzer/trimmer for repair and/or calibration.
NOTE To obtain an accurate EGT reading on cockpit indicator, it may be necessary to tap indicator lightly with fingers.		
j. Record cockpit EGT indicator reading and compare with reading on TEMP °C display.	Cockpit EGT indicator reads within ±5°C of TEMP °C display.	1. Replace EGT indicator. 2. Troubleshoot EGT indicator circuit. Refer to TO 1F-4C-2-11.
k. Position controls as follows: (1) On Probe Controller Panel (a) FUNCTION SELECT switch-OFF (b) A/C IND ADJ knob - full counterclockwise (2) On Trim Module Panel (a) TEMPERATURE switch - CAL 600°C (b) MASTER POWER switch - off		
l. Remove external electrical power from aircraft and analyzer/trimmer.		

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
m. *Remove instrument cable and instrument cable adapter from engine and analyzer/ trimmer.* n. *Connect aircraft EGT indicator connector at engine electrical disconnect bracket and lockwire.* o. *Record Jetcal accomplishment on aircraft forms.* p. If Jetcal checkout is complete, *connect actuator to door 81L and R and close door 82L if required.*		

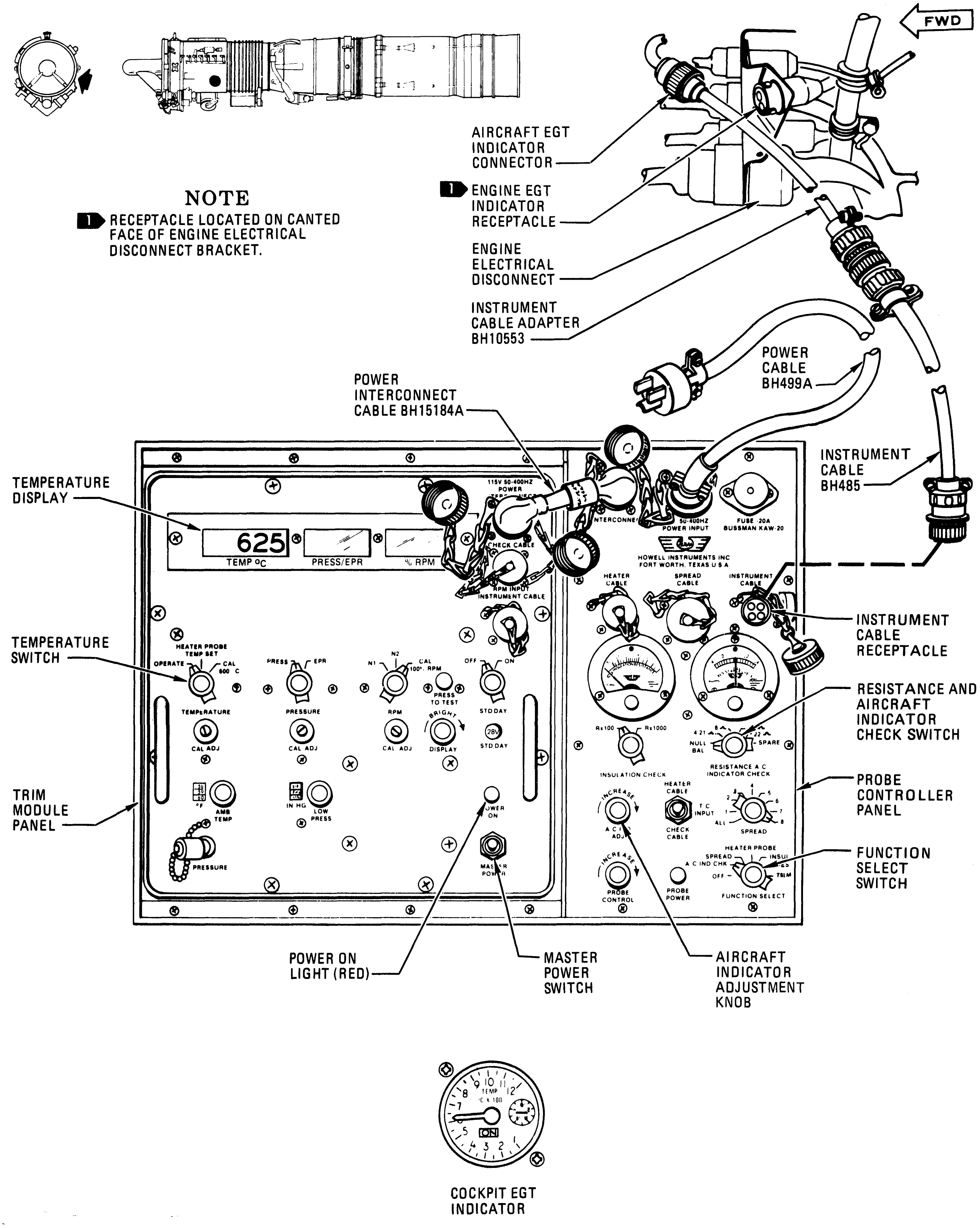


Figure 2-27G. BH112JB-40 Jetcal Analyzer/Trimmer - Exhaust Gas Temperature Indicator Check

2-80J. **BH112JB-40 Jetcal Analyzer/Trimmer - Tachometer System Check.**
When performing the tachometer system check, the engine speed is accurately displayed on the analyzer/ trimmer in percent of RPM. At the same time, the cockpit mounted tachometer is also indicating engine speed in percent of RPM and, the difference between the two indications is aircraft system error. If system error exceeds allowable limits, corrective maintenance must be performed. Corrective maintenance if defined as replacement of aircraft tachometer or engine tach generator, also repair of aircraft or engine electrical wiring could be required. See figure 2-27H.

Tools and Equipment.

Jetcal analyzer/trimmer, BH112JB-40
Adapter, RPM check, BH907
Cable, instrument, BH485
Power source, external electrical 115Vac, 50 to 400Hz single phase

Materials.

Lockwire, MS20995NC20

Manpower Requirement.

Two men required.

Procedure	Normal Indication	Remedy for Abnormal Indication
WARNING To prevent injury to personnel, make sure safety struts are installed on door 81L and R actuators. Doors will close if electrical power is interrupted with hydraulic power applied.		
CAUTION Aircraft throttle system must be correctly rigged before performing this check.		
a. Open doors 73L and 74L or door 74R if right engine is to be checked.		
b. Make sure initial check of the analyzer/ trimmer has been performed. Refer to para 2-80B.		
c. Position switches as follows:		
(1) On Trim Module Panel		
(a) STD DAY switch - OFF		
(b) MASTER POWER switch - off		
(c) RPM switch - N2		
d. Remove lockwire and disconnect engine tachometer generator electrical connector.		
e. Connect RPM check adapter BH907 to tachometer generator receptacle and electrical connector.		
f. Connect remaining end of RPM check adapter to instrument cable BH485.		
g. On trim module panel, connect remaining end of instrument cable to RPM INPUT INSTRUMENT CABLE receptacle.		

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
NOTE A 15 minute warmup time is required to prevent incorrect readings during operation.		
h. On trim module panel, turn MASTER POWER switch to on. Allow 15 minutes warm-up time.	POWER ON light comes on and % RPM display reads 0% RPM.	1. Make sure power cable is connected to external electrical power source. 2. Check lamp. Replace if defective. 3. Check fuse. Replace if defective. 4. Return analyzer/trimmer for repair and/or calibration.
i. Start engine and stabilize at IDLE. Refer to TO 1F-4C-2-8CL-1.	1. Analyzer/trimmer % RPM display reads 64 to 66 percent RPM.	Perform engine speed adjustment. Refer to para 4-137A.
NOTE Engine speed can be adjusted to high or low side of tolerance band to bring cockpit indicator within limits.		
	2. Front and rear cockpit tachometer indicators read 64 to 66 percent and are within ±0.5 percent of % RPM display on analyzer/trimmer. Example (acceptable condition): 64.6 percent RPM read on front cockpit indicator minus 64.3 read on % RPM display is 0.3 percent RPM difference.	
CAUTION Avoid engine overspeed and overtemperature.		
j. Advance throttle to MIL and stabilize.	1. Analyzer/trimmer % RPM display reads within MIL RPM limits specified in fig 2 11.	Perform engine speed ad justment. Refer to para 4-137A.
NOTE Engine speed can be adjusted to high or low side of tolerance band to bring cockpit indicator within limits.		

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
	2. Front and rear cockpit tachometer indicators read within MIL RPM limits specified in fig 2-11 and are within ±0.5 percent of % RPM display on analyzer/trimmer. Example (acceptable condition): 98.4 percent RPM read on rear cockpit indicator minus 98.2 read on % RPM display is 0.2 percent RPM difference.	1. Replace tachometer indicator. 2. Refer to TO 1F-4C-2-11.
k. Shut down engine. Refer to TO 1F-4C-2-8CL-1.		
l. On trim module panel, position MASTER POWER switch off.	All lights and displays go out.	
m. Remove RPM check adapter from tachometer indicator connector.		
n. *Connect tachometer indicator connector to tachometer generator receptacle and lockwire.*		
o. *Close doors 73L and 74L or 74R.*		
p. *Record Jetcal accomplishment on aircraft forms.*		

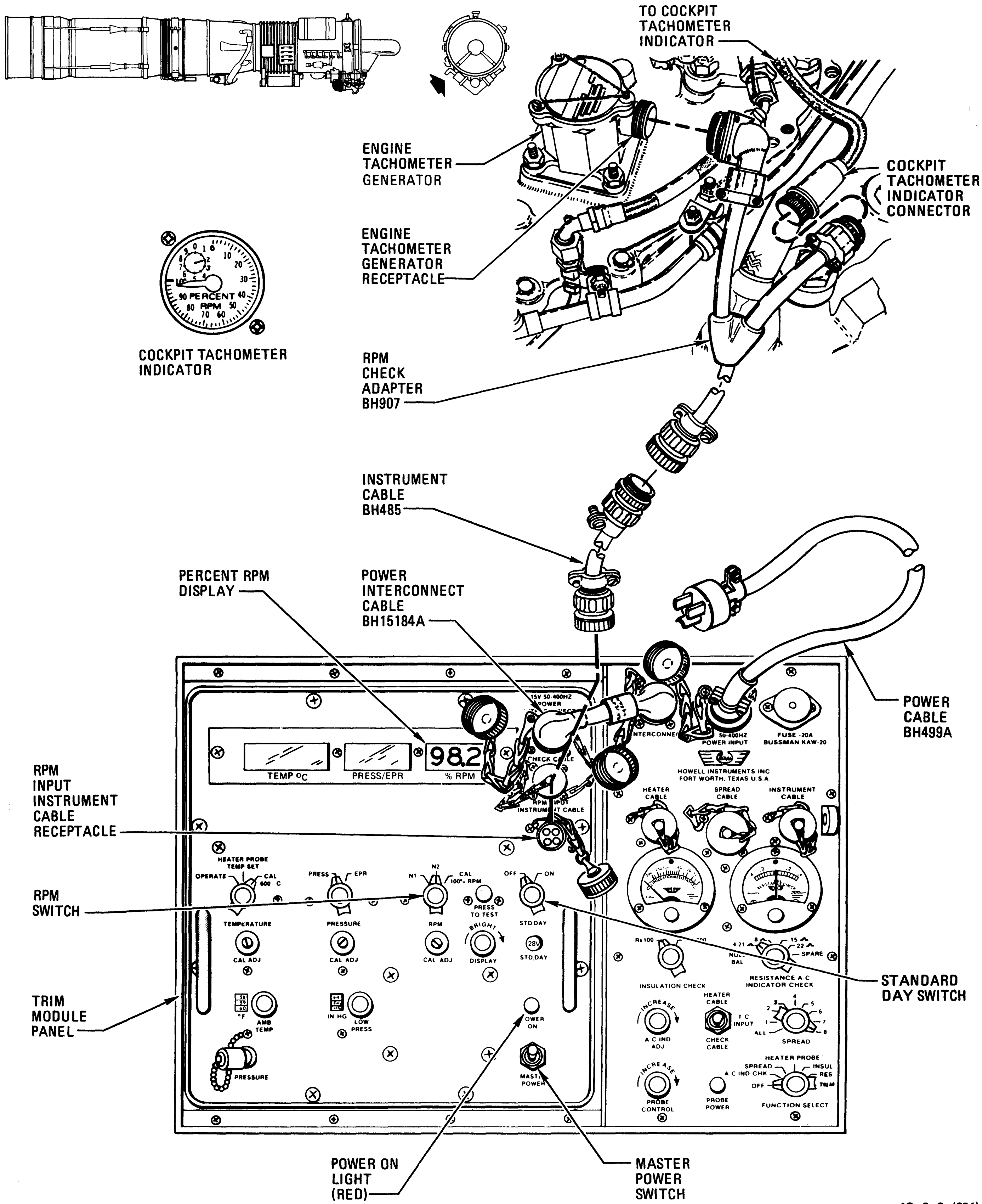


Figure 2-27H. BH112JB-40 Jetcal Analyzer/Trimmer - Tachometer System Check

2-80K. BH112JB-40 Jetcal Analyzer/Trimmer-Fire Detector System Test.

The fire detector system test checks the fire warning elements and related circuitry by simulating an engine compartment fire. As the Tempcal heater probe applies heat to the sensing element, resistance of the insulating compound lowers. This allows current to flow from the center conductor to the outer tube, which is grounded, and illuminates cockpit FIRE warning light. If a sensing element is dented, cut or bent but still within limits, a check of the system should be made by applying heat to the damaged area. This will ensure servicability of the fire warning element. See figure 2-27J.

Tools and Equipment.

Jetcal analyzer/trimmer, BH112JB-40
Cable, heater, BH405
Heater probe, Tempcal, BH1278
Power source, aircraft external electrical
Power source, external electrical 115Vac, 50 to 400Hz, single phase

Manpower Requirements.

Two men required.

Procedure	Normal Indication	Remedy for Abnormal Indication
NOTE A check of the fire detector sensing element on door 92L or R can be made by opening doors 83L or R or 96L or R.		
a. Open door 83L or R.		
b. Make sure initial check of the analyzer/trimmer has been performed. Refer to para 2-80B.		
c. Position controls as follows:		
(1) On Probe Controller Panel		
(a) FUNCTION SELECT switch - OFF		
(b) PROBE CONTROL knob - full counterclockwise		
(c) T/C INPUT switch - HEATER CABLE		
(2) On Trim Module Panel		
(a) MASTER POWER switch - off		
(b) TEMPERATURE switch - HEATER PROBE TEMP SET		
(c) STD DAY switch - OFF		
d. Connect heater cable BH405 to Tempcal heater probe BH1278.		
e. Clamp Tempcal heater probe on applicable engine fire detector sensing element.		
f. Connect heater cable to HEATER CABLE receptacle on probe controller.		
NOTE A 15 minute warmup time is required to prevent incorrect readings during operation.		

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
g. Position FUNCTION SELECT switch to HEATER PROBE and MASTER POWER switch to on. Allow 15 minutes warmup time.	POWER ON light comes on.	1. Make sure power cable is connected to external electrical power source. 2. Check lamp. Replace if defective. 3. Check fuse. Replace if defective. 4. Return analyzer/trimmer for repair and/or calibration.
h. Apply external electrical power to aircraft.		
i. Press FIRE TEST switch on forward cockpit main instrument panel.	FIRE warning light come on.	1. Make sure circuit breakers are set. 2. Check lamps. Replace if defective. 3. Troubleshoot fire detector system. Refer to TO 1F-4C-2-13.
j. Turn PROBE CONTROL clockwise to obtain 350°C.	TEMP °C display reads 350°C.	Return analyzer/trimmer for repair and/or calibration.

NOTE

While Tempcal heater probe is heating, PROBE POWER light is on steady. The probe control will overshoot test temperature and PROBE POWER light will go out until probe temperature drops and stabilizes at test temperature. When probe temperature stabilizes at test temperature, PROBE POWER light flashes.

Procedure	Normal Indication	Remedy for Abnormal Indication
k. Position TEMPERATURE switch to OPERATE.	PROBE POWER light flashes and TEMP °C display reads 350°C.	1. Make sure heater cable and Tempcal heater probe connections are tight. 2. Replace defective Tempcal heater probe. 3. Return analyzer/trimmer for repair and/or calibration.

CAUTION

To prevent damage to the fire detector system, do not allow Tempcal heater probe to exceed 650°C.

When testing fire detector system on left engine, make sure left engine FIRE detector warning light in forward cockpit comes on. When testing right engine, make sure right engine FIRE detector warning light comes on.

Procedure	Normal Indication	Remedy for Abnormal Indication
l. Position TEMPERATURE switch to HEATER PROBE TEMP SET and turn PROBE CONTROL clockwise to obtain 428°C.	TEMP °C display reads 428°.	Return analyzer/trimmer for repair and/or calibration.

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
m. Position TEMPERATURE switch to OPERATE and observe forward cockpit FIRE detector warning light.	The applicable FIRE warning light comes on and stays on between 387° and 428℃.	1. Make sure Tempcal heater probe is properly attached to sensing element and cable connections are tight. 2. Replace defective Tempcal heater probe. 3. Perform engine fire detector sensing element loop test or electrical performance test. Refer to TO 1F-4C-2-13.
n. Turn PROBE CONTROL full counterclockwise and observe forward cockpit FIRE detector warning light.	The applicable FIRE warning light goes out before TEMP ℃ display reads 387℃.	Perform engine fire detector sensing element loop test or electrical performance test. Refer to TO 1F-4C-2-13.
o. Position TEMPERATURE switch to CAL 600℃, FUNCTION SELECT switch to OFF and MASTER POWER switch to off.	All lights and displays go out.	
p. Remove external electrical power from aircraft and analyzer/trimmer.		

WARNING

To prevent injury to personnel and damage to equipment, allow Tempcal heater probe to cool before storage.

q. *Remove Tempcal heater probe from fire detector sensing element.* Disconnect power cable and heater cable from analyzer/ trimmer.		
r. *Close door 83L or R.*		

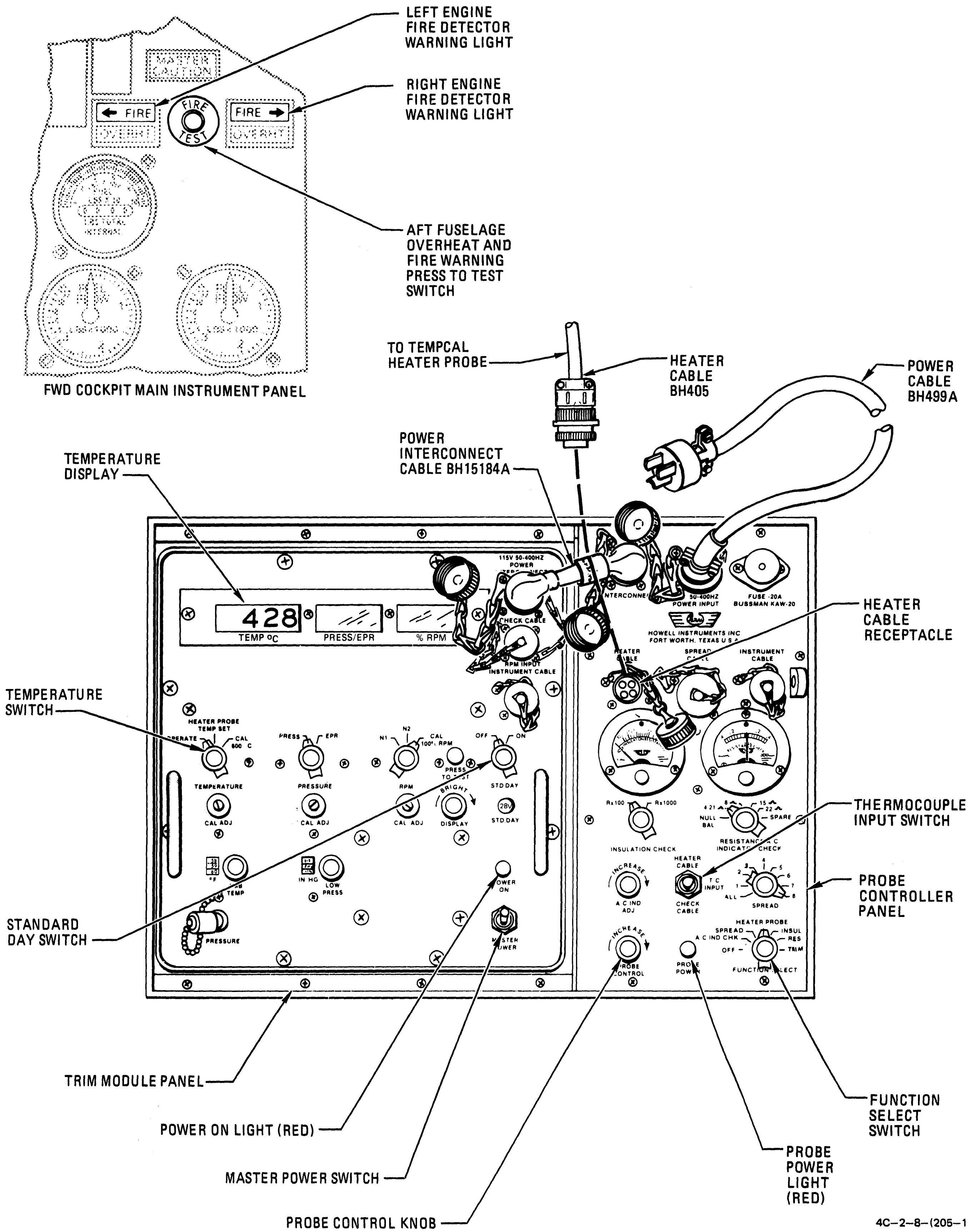


Figure 2-27J. BH112JB-40 Jetcal Analyzer/Trimmer - Fire Detector System Test
(Sheet 1 of 2)

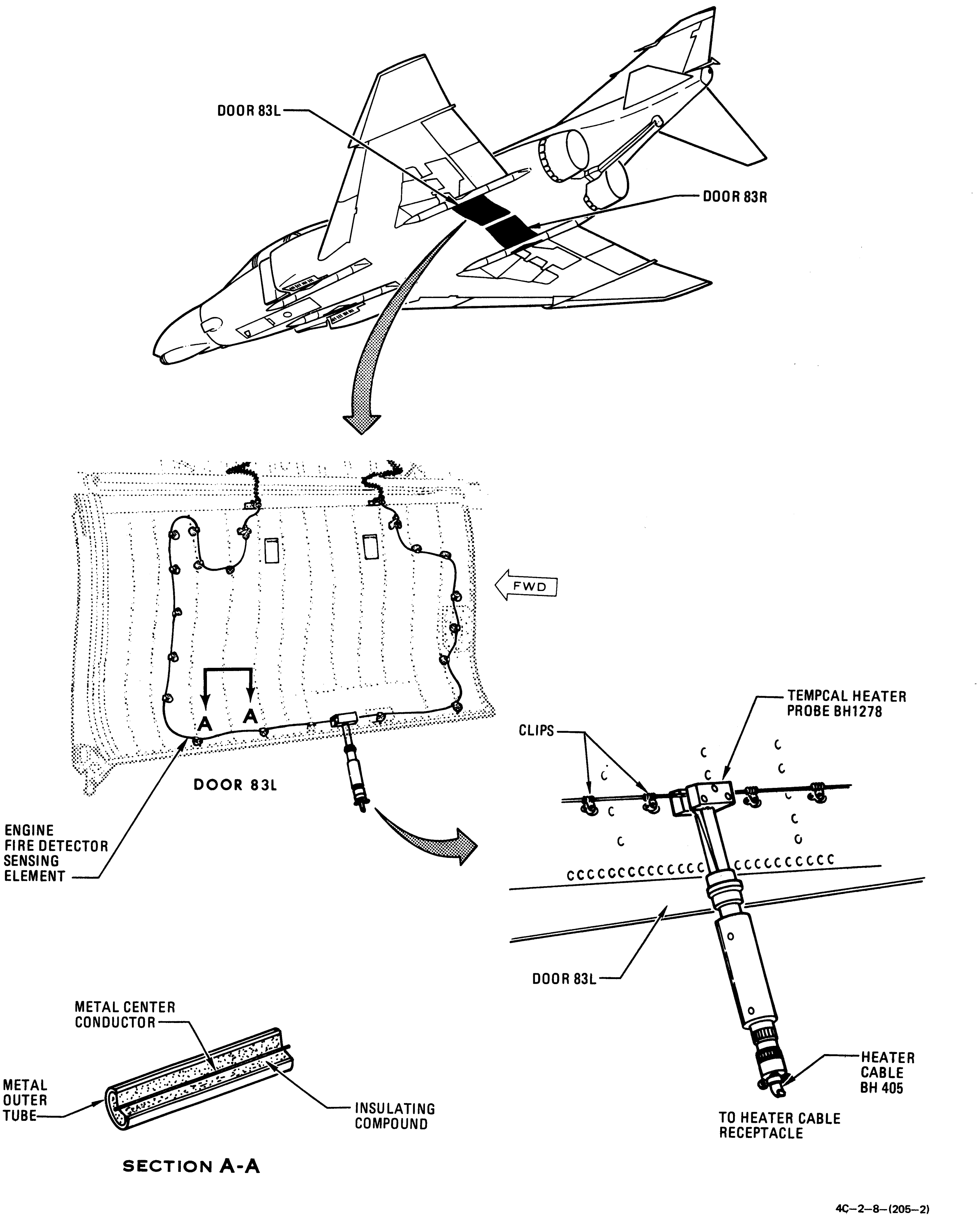


Figure 2-27J. BH112JB-40 Jetcal Analyzer /Trimmer -Fire Detector System Test
(Sheet 2 of 2)

2-80L. **BH112JB-40 Jetcal Analyzer/Trimmer - Aft Fuselage Overheat Detector System Test.**
The aft fuselage overheat detector system test checks the overheat sensing element and related circuitry by simulating an aft fuselage overheat condition. As the Tempcal heater probe applies heat to the sensing element, resistance of the insulating compound lowers. This allows current to flow from the center conductor to the metal outer tube, which is grounded, and illuminates the cockpit aft fuselage overheat warning lights (See section B-B, figure 2-27K). If the sensing element is dented, cut or bent but still within limits, a check of the overheat system should be made by applying heat to the damaged area. This will ensure serviceability of the overheat sensing element. See figure 2-27K.

Tools and Equipment.

Jetcal analyzer/trimmer, BH112JB-40
Cable, heater, BH405
Heater probe, Tempcal, BH1278
Power source, aircraft external electrical
Power source, external electrical 115Vac, 50 to 400 Hz, single phase

Materials.

Lockwire, MS20995NC20

Manpower Requirements.

Two men required.

Procedure	Normal Indication	Remedy for Abnormal Indication
a. Make sure initial check of analyzer/trimmer has been performed. Refer to para 2-80B.		
b. Position controls as follows:		
(1) On Probe Controller panel		
(a) FUNCTION SELECT switch - OFF		
(b) T/C INPUT switch - HEATER CABLE		
(c) PROBE CONTROL knob - full counterclockwise.		
(2) On Trim Module Panel		
(a) STD DAY switch - OFF		
(b) TEMPERATURE switch - HEATER PROBE TEMP SET		
(c) MASTER POWER switch - off		

NOTE

Exhaust nozzle flaps must be closed to provide access to aft fuselage overheat sensing element.

At least three safety clips must be opened and sensing element released from clips before heater probe can be attached.

Procedure	Normal Indication	Remedy for Abnormal Indication
c. Remove lockwire and unfasten three overheat sensing element safety clips. See detail A.		
d. Connect heater cable BH405 to Tempcal heater probe BH1278.		

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
e. Clamp Tempcal heater probe to aft fuselage overheat sensing element.		
f. Connect heater cable to HEATER CABLE receptacle on probe controller panel.		

NOTE

A 15 minute warmup time is required to prevent incorrect reading during operation.

Procedure	Normal Indication	Remedy for Abnormal Indication
g. On trim module, turn MASTER POWER switch to on. Allow 15 minutes warmup time.	POWER ON light comes on.	1. Make sure power cable is connected to external electrical power source. 2. Check lamp. Replace if defective. 3. Check fuse. Replace if defective. 4. Return analyzer/trimmer for repair and/or calibration.
h. Apply external electrical power to aircraft.		
i. Press FIRE TEST switch on forward cockpit main instrument panel.	OVERHT lights come on.	1. Make sure circuit breakers are set. 2. Check lamps. Replace if defective. 3. Troubleshoot aft fuselage overheat detector system. Refer to TO 1F-4C-2-13.
j. On probe controller panel, position FUNCTION SELECT switch to HEATER PROBE.		
k. Turn PROBE CONTROL clockwise to obtain 500°C.	TEMP °C display reads 500°C	Return analyzer/trimmer for repair and/or calibration.

NOTE

While Tempcal heater probe is heating, PROBE POWER light is on steady. The probe control will overshoot the test temperature and PROBE POWER light will go out until probe temperature drops and stabilizes at the test temperature. When probe temperature stabilizes at test temperature, PROBE POWER light flashes.

Procedure	Normal Indication	Remedy for Abnormal Indication
l. Position TEMPERATURE switch to OPERATE.	PROBE POWER light flashes and TEMP °C display reads 500°C.	1. Make sure heater cable and Tempcal heater probe connections are tight. 2. Replace defective Tempcal heater probe. 3. Return analyzer/trimmer for repair and/or calibration.

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
m. Position TEMPERATURE switch to HEATER PROBE TEMP SET and turn PROBE CONTROL clockwise to obtain 595°C.	TEMP°C display reads 595°C.	Return analyzer/trimmer for repair and/or calibration.

CAUTION

To prevent damage to the aft fuselage overheat detector system, do not allow Tempcal heater probe to exceed 650°C.

When testing aft fuselage overheat detector system on the left side, make sure left OVERHT warning light in forward cockpit comes on. When testing right side, make sure OVERHT warn- light comes on.

Procedure	Normal Indication	Remedy for Abnormal Indication
n. Position TEMPERATURE switch to OPERATE and observe OVERHT warning light in forward cockpit.	The applicable OVERHT warning light comes on and stays on between 536° and 595°C read on TEMP °C display.	1. Make sure Tempcal heater probe is properly attached to sensing element and cable connections are tight. 2. Replace defective Tempcal heater probe. 3. Perform aft fuselage overheat sensing element loop test or electrical performance test. Refer to TO 1F-4C-2-13.
o. Turn PROBE CONTROL full counterclockwise and observe forward cockpit OVERHT detector warning light.	The applicable OVERHT light goes out before TEMP °C display reads 536°C.	Perform aft fuselage overheat sensing element loop test or electrical performance test. Refer to TO 1F-4C-2-13.
p. Position TEMPERATURE switch to CAL 600°C, FUNCTION SELECT switch to OFF and MASTER POWER switch to off.	All lights and displays go out.	
q. Remove external electrical power from aircraft and analyzer/trimmer.		

WARNING

To prevent injury to personnel and damage to equipment, allow Tempcal heater probe to cool before storage.

Procedure	Normal Indication	Remedy for Abnormal Indication
r. *Remove Tempcal heater probe from sensing element.* Disconnect power cable and heater from analyzer/trimmer.		
s. *Secure overheat sensing element clips and lockwire. See detail C.*		

2-81 thru 2-81C. Deleted.

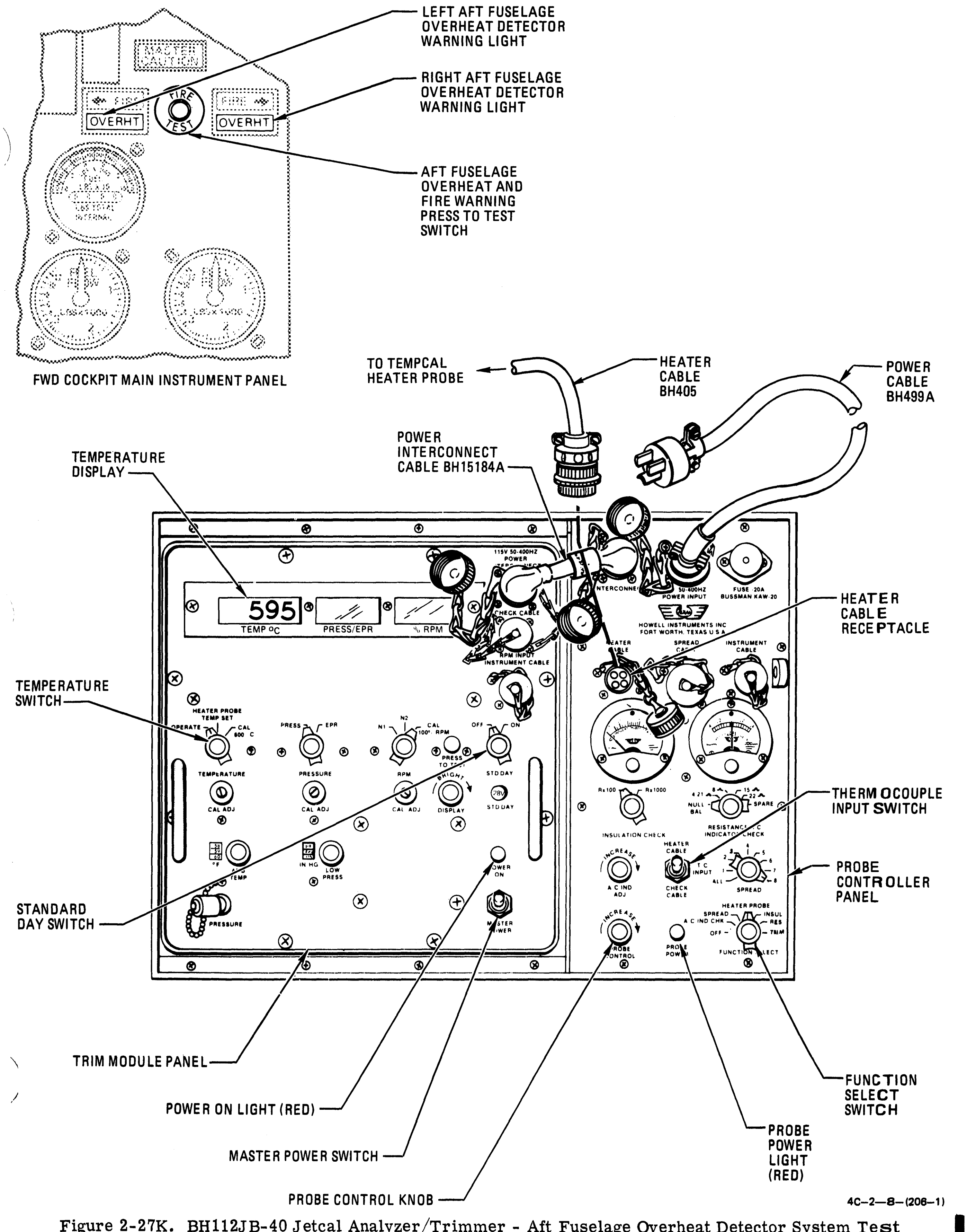


Figure 2-27K. BH112JB-40 Jetcal Analyzer/Trimmer - Aft Fuselage Overheat Detector System Test

(Sheet 1 of 2)

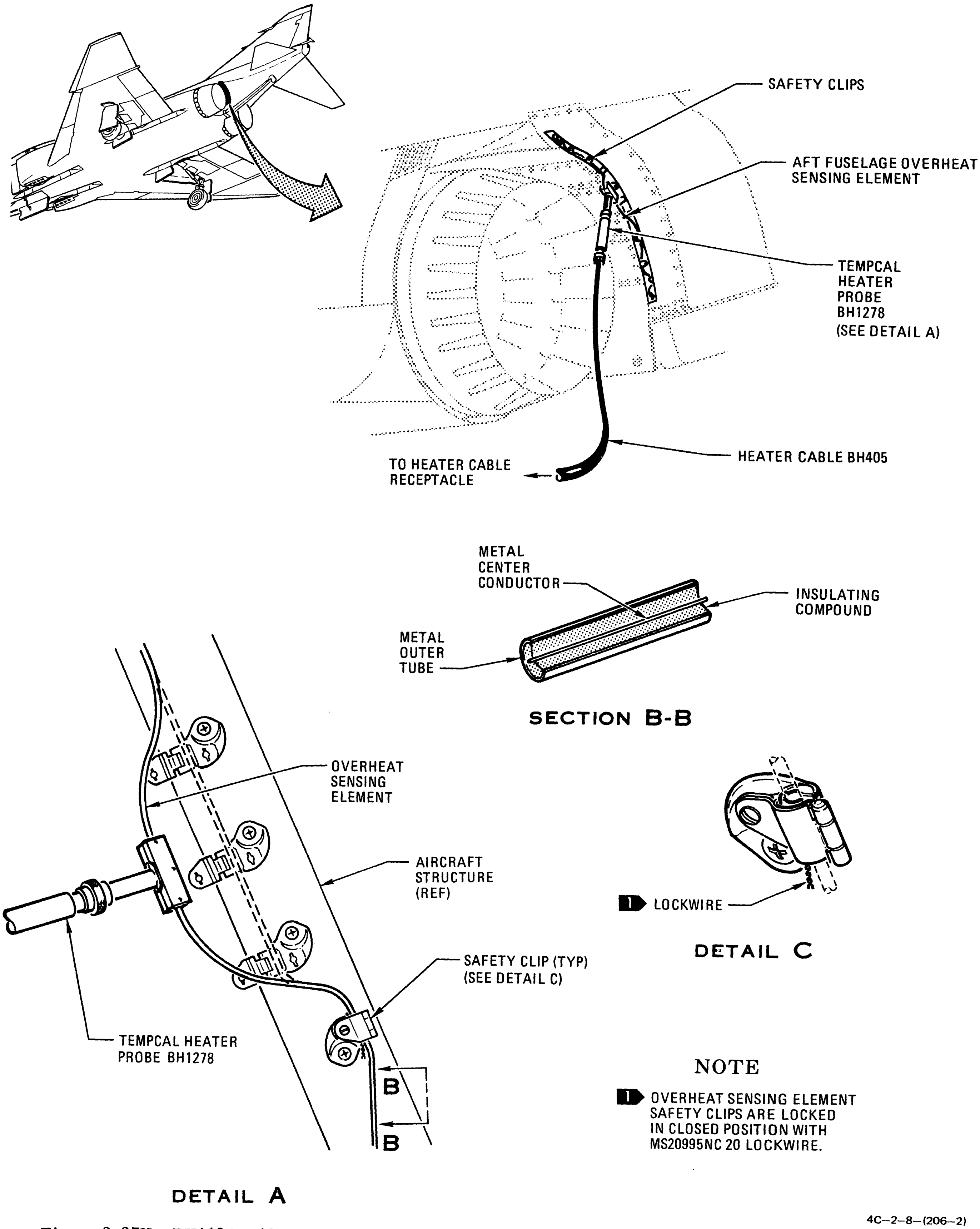


Figure 2-27K. BH112JB-40 Jetcal Analyzer/Trimmer - Aft Fuselage Overheat Detector System Test (Sheet 2 of 2)

"All data on page 2-71, including figure 2-28 deleted."

2-82. TROUBLESHOOTING.

2-83. Troubleshooting information is provided to isolate malfunctions to a line replaceable unit and/or aircraft wiring, cabling or plumbing. This data consists of symptom index, schematics and troubleshooting procedures. A symptom index of operational malfunctions is included in this section and is repeated in the master troubleshooting manual T.O.1F-4C-2-34. The index is arranged in alphabetical order to direct the user to specific troubleshooting procedures. Symptoms caused by complex interaction between two or more systems are covered in T.O.1F-4C-2-34. Troubleshooting is based on the supposition that the observed symptom is caused by a single malfunction.

Table 2-3. Symptom Index

Indication Of Trouble	Troubleshooting Procedure (Refer to)
AFTERBURNER	
No afterburner light	Paragraph 2-84
Slow afterburner light	Paragraph 2-93
Slow afterburner termination	Paragraph 2-85
Afterburner surge	Paragraph 2-94
ANTI-ICING	
No anti-icing indication	Paragraph 2-86
CIRCUIT BREAKER POPS	
R Main Ignition (5CB304)	Section III
L Afterburner Ignition (5CB305)	Section III
R Afterburner Ignition (5CB306)	Section III
L Main Ignition (5CB307)	Section III
L Ign Unit #1 (5CB311)	Section III
R Ign Unit #1 (5CB312)	Section III
L Ign Unit #2 (5CB313)	Section III
R Ign Unit #2 (5CB314)	Section III
Anti-ice (39CB301)	Section X
COMPRESSOR	
Compressor stall Refer to T.O.1F-4C-2-8CL-2 before troubleshooting this symptom	Paragraph 2-87
Rough or vibrating engine	Paragraph 2-88
Engine surge and loss of thrust	T.O.1F-4C-2-9
FUEL	
High EGT	Paragraph 2-90
Low EGT	Paragraph 2-89
Fuel flow out of limits	Replace main fuel control
No or slow acceleration to IDLE	Paragraph 2-109
Slow acceleration IDLE to MIL	Paragraph 2-91
No or slow fuel dump on shutdown	Replace pressurizing and drain valve
IGNITION	
Main ignition system fails to operate or operates at incorrect rate	Paragraph 2-50
Afterburner ignition system fails to operate or operates at incorrect rate	Paragraph 2-51
VARIABLE EXHAUST NOZZLE	
Nozzle erratic	Paragraph 2-97
Nozzle position out of limits	Paragraph 2-97
Nozzle fails open or closed	Paragraph 2-99

CONTINUED

Table 2-3. Symptom Index

Indication Of Trouble	Troubleshooting Procedure (Refer to)
VARIABLE EXHAUST NOZZLE (Cont.)	
EGT high in AB only	Paragraph 2-96
Fluctuating, high or low EGT	Clean thermocouple connectors, refer to section VII.
LUBRICATION	
High oil pressure	Paragraph 2-105
Low oil pressure	Paragraph 2-101
High oil consumption	Paragraph 2-100
Oil leakage in tailpipe or strut 5 or strut 6	Paragraph 2-103
More than 14 pints of oil required to service engine	Paragraph 2-105
Oil system venting overboard	Paragraph 2-104
Suspected CSD failure	Paragraph 2-105
Engine oil pressure remains constant at all power settings	Check for faulty oil pressure transmitter. Replace transmitter.
Oil pressure fluctuates	Check filters for contamination. Inspect and clean as necessary.
Unexplained CSD failure	Check for crack of overfill boss or tube by making an oil tank capacity check as follows with engine installed in aircraft: 1. Drain oil from tank at drain fitting or disconnect line to oil servicing bracket. This leaves 0.9 gallon of oil trapped in oil tank hydraulic compartment. 2. Service oil tank in normal manner and note quantity of oil supplied when oil starts to flow from overfill drain line. 3. Normal oil service should be 4.4 $\pm$0.2 gallons. If overfill tube is cracked internally, service will only be approximately 2.1 gallons. If this condition exists, reject tank.
Oil pressure exceeds +5, −10 psi of placard value in cockpit indicator	Install differential pressure gage to oil pressure tap and to sump pressure line. Run engine and compare reading of differential pressure gage to reading of cockpit gage. If pressure exceeds +5, −10 psi replace cockpit gage or transmitter.

CONTINUED

Table 2-3. Symptom Index

Indication Of Trouble	Troubleshooting Procedure (Refer to)
LUBRICATION (Cont.)	
NOTE Accumulation of oil in tailpipe can result from extended periods of operation at IDLE. If this occurs, operate engine at higher power setting prior to shutdown, then recheck.	
Oil puddles in tailpipe, or gearbox leakage	This indicates leakage of lube and hydraulic static relief valve. Replace parts as required.
RPM	
IDLE RPM out of limits	Refer to paragraph 2-114
MIL RPM out of limits	Paragraph 2-106
RPM decay out of limits during afterburner	Paragraph 2-95
STARTING	
No engine rotation - pneumatic start	Paragraph 2-110
No engine rotation - cartridge start	Paragraph 2-111
No engine light	Paragraph 2-92
Hot start	Paragraph 2-108
THROTTLE	
Excessive system friction	Paragraph 2-115
Throttle lever will only move in one direction with torque booster pressurized.	Inspect for loose clockwise or counterclockwise valve stop screw on torque booster. Replace torque booster.
Starting speed reached - no start - no fuel flow.	Paragraph 2-116
Starting speed reached - no start - low fuel flow.	Paragraph 2-117
Force required to disengage aft cockpit throttle lever load limiter is out of tolerance	If force required was below minimum allowable, remove aft cockpit throttle quadrant and shim load limiter spring or install a new spring. If force required was above maximum allowable, remove aft cockpit throttle quadrant and inspect the plunger and bellcrank for nicks or burrs. Install new plunger and/or bellcrank.
Forward cockpit throttle levers not aligned at positions other than IDLE	Perform a rigging check. Refer to section IV. After right system is correctly rigged, align left throttle lever with right.
Nibbling or continuous afterburner operation with throttle lever in MIL.	Paragraph 2-118
Forward cockpit throttle lever shift breakout force is out of limits	Adjust shift breakout force. Refer to section IV
Idle instability	Paragraph 2-119
High starting fuel flow	Replace main fuel control.
No positive fuel shutoff when throttle lever is chopped to OFF	Paragraph 2-120

CONTINUED

Table 2-3. Symptom Index

Indication Of Trouble	Troubleshooting Procedure (Refer to)
THROTTLE (Cont.)	
Fluctuating fuel flow and/or RPM..	Perform an engine control box wear check, refer to section IV. Remove and replace control box. If fluctuation still exists, check for motoring torque booster. Replace torque booster.
Excessive force required to move forward cockpit throttle lever when a side load is applied..	Remove and disassemble the throttle quadrant. Inspect power lever bushings and shaft for evidence of galling. Replace lower lever and shaft.
Excessive force required to move throttle lever with engine operating or torque booster pressurized. System friction is within limits. Force required to move throttle lever with system connected to the engine and torque booster pressurized should not exceed system friction by more than 2 pounds..........	1. With airframe power plant control system disconnected from main fuel control and torque booster pressurized, utilize adapter 1C2754-3G to check amount of torque required to rotate torque booster input shaft. If torque exceeds 5 inch-pounds, check engine control system friction. Refer to section IV. 2. Torque required to rotate unpressurized torque booster should not exceed 40 inch -pounds. 3. If torque required to rotate torque booster input shaft is within limits, check amount of torque required to rotate engine control box universal joints. If torque required exceeds 9 inch-pounds, replace control box.
Excessive engine control box wear..	Replace engine control box.
Engine starts but flames out soon after......................................	Paragraph 2-116
Engine manifold shutoff valve operates slowly and/or only opens partially......	1. Apply 28 Vdc directly to valve pin A to open, pin B to close. Replace valve if it does not operate satisfactorily. 2. Check for high resistance across following switches: (a) Boost pump check - normal contacts. (b) Throttle cutoff - normally closed contacts. (c) Engine master - applicable ON contacts. Replace defective switch.

CONTINUED

Table 2-3. Symptom Index

Indication Of Trouble	Troubleshooting Procedure (Refer to)
THROTTLE (Cont.)	
Minimum fuel flow drops below 225 pph during rapid decel.	1. Observe position of cam notch through rig pin port of main fuel control or vernier reference marks. 2. Perform snap decel to IDLE and observe position of cam notch through rig pin port of main fuel control. (a) If cam notch vernier position varies, perform a control box wear check and system rigging check. (b) Perform a power plant control system rigging check. Refer to section IV. (c) If minimum fuel flow drops below value given and control box wear check is within limits, fuel flow transmitter or indicator may be at fault. Check indicating system. (d) Do not reject a main fuel control for low fuel flow readings until above checks have been performed.
Engine control box universal joints stiff.	Perform engine control box universal joint friction check, refer to paragraph 2-58.
Engine stalls or flames out during deceleration.	Paragraph 2-121
VARIABLE VANE	
Vanes do not follow schedule or are otherwise unstable.	Paragraph 2-112
V max low with slow acceleration.	T.O.1F-4C-2-9

2-84. DELAYED OR NO AFTERBURNER LIGHT.

	NO	YES
a. Is torch igniter lighting properly when AB is selected?	b	c
b. Is torch igniter plug immersion depth correct?	d	e
c. Are spraybars bulged or broken?	f	g
d. Adjust immersion depth to proper value.	–	–
e. Is torch igniter including fuel and air orifices free of carbon, and basket in good condition?	h	i
f. Change AB pressurizing valve.	–	–
g. Replace spraybars if possible.	–	–
h. Clean and/or replace parts as necessary.	–	–
i. Is AB ignition switch operating properly (pressure check or jumper switch)?	j	k
j. Replace AB ignition switch.	–	–
k. Is torch igniter plug firing and is firing rate as specified?	l	p
l. Is there electrical power to ignition unit?	m	n

	NO	YES
m. Check power source output, circuit breakers and leads.	–	–
n. Slave in AB ignition unit. Is firing rate correct?	o	r
o. Replace igniter plug. Is firing rate correct?	s	t
p. Disconnect overboard drain line at downstream fitting of drain manifold and attach a 2 to 3 foot length of hose. Was flow present?	q	u
q. Install a 0 to 1000 psi pressure gage in AB on off signal line from main fuel control to AB pump. Is signal pressure present when MFC is in AB range?	w	x
r. Replace AB ignition unit.	–	–
s. Check electrical harness and leads for continuity and shorts.	–	–
t. Return engine to service.	–	–
u. Flow should normally be a spurt. Was fuel flow steady?	z	y
v. Check fuel filter union in signal port of torch igniter on off valve. Is filter clean and properly positioned?	aa	ac
w. Replace main fuel control.	–	–
x. Replace AB fuel pump.	–	–
y. Replace AB fuel pump vent valve.	–	–
z. Disconnect torch ignition on off valve output line and connect a long length of clean slave hose to valve to carry outlet fuel to a container. Start engine and advance throttle into afterburner. Fuel flow from valve should be approximately 2 gallons per hour. Is fuel flow correct?	v	ab
aa. Clean, replace, or reposition union properly.	–	–
ab. Inspect torch igniter check valve for cleanliness and proper operation. Also check line connections for leaks. Correct as necessary.	–	–
ac. Replace torch igniter on–off valve.	–	–

2-85. ENGINE SLOW COMING OUT OF AFTERBURNER.

	NO	YES
a. Is aircraft to engine throttle system rigged correctly, free from looseness, and worn parts?	b	c
b. Rerig and/or replace worn parts as necessary.	–	–
c. Connect a 2 to 3 foot length of hose to downstream connector of drain manifold. Observe overboard drainage hose on termination of AB. Is AB pump vent valve draining properly when coming off AB?	d	e
d. Replace AB pump vent valve.	–	–
e. Inspect filter union in torch ignitor on–off valve. Is it clean and positioned properly?	f	g
f. Clean and/or reposition union.	–	–
g. Install 0 to 1000 psi gage in on–off signal line from main fuel control to AB fuel pump. Is signal present when throttle is retarded out of AB range?	h	i

NOTE

There should be no AB fuel pump discharge pressure when throttle is retarded below MIN AB range.

	NO	YES
h. If AB fuel pump discharge pressure is present with no MFC on–off signal, replace AB fuel pump.	–	–
i. Replace main fuel control.	–	–

2-86. ANTI-ICING LIGHT DOES NOT ILLUMINATE ON ACTUATING ANTI-ICING SWITCH.

	NO	YES
a. Did exhaust gas temperature rise without cockpit light illuminating?	b	c
b. Check for 115 Vac, 400 Hz at pin A of airframe electrical connector 52P636R or 52P632L. Is voltage present?	d	e
c. Are signal and reference pressure lines correctly assembled between valve and indicating light?	f	g

	NO	YES
d. Troubleshoot power supply system.	–	–
e. Replace anti-icing valve.	–	–
f. Correct assembly of pressure lines and repeat checkout.	–	–
g. Check circuit between switch and light for continuity. Does circuit check satisfactory?	h	i
h. Rework as necessary to correct circuitry.	–	–
i. Replace light bulb and repeat checkout. If light does not come on, replace switch.	–	–

2-87. ENGINE STALLS OR HANGS UP DURING ACCELERATION.

	NO	YES
a. Does engine have compressor or turbine FOD?	b	c
b. Is main fuel control specific gravity adjustment set at specific gravity of fuel being used?	d	e
c. Rework or replace parts as necessary.	–	–
d. Set specific gravity at proper values.	–	–
e. Inspect bleed air ducting and both check valves for leakage. Is leakage present?	f	g
f. Are variable vanes tracking properly and is running null within limits?	h	i
g. Correct malfunction.	–	–
h. Rerig variable vanes or replace CIT sensor as required.	–	–
i. Is exhaust nozzle rigged correctly and nozzle feedback system operating freely?	j	k
j. Rerig nozzle. Replace parts and/or lubricate feedback system as necessary.	–	–
k. Slave in good temperature amplifier. Does amplifier correct problem?	m	l
l. Replace temperature amplifier.	–	–
m. Does nozzle area control output shaft and nozzle pump arm operate smoothly?	n	o
n. Isolate sticky or binding nozzle area control or nozzle pump and replace as required.	–	–
o. Replace main fuel control.	–	–

2-88. ROUGH OR VIBRATING ENGINE.

	NO	YES
a. Does compressor or turbine show evidence of FOD?	b	c
b. Are engine mounts secure?	d	e
c. Refer to section XII limits.	–	–
d. Replace or retorque as necessary.	–	–
e. Are hydraulic pump clamps and adapters secure?	f	g
f. Replace defective component.	–	–
g. Do variable vanes follow schedule?	h	i
h. Rig variable vanes.	–	–
i. Perform SOAP check on engine and CSD oil. Is check satisfactory?	j	k
j. Return engine to next higher maintenance level.	–	–
k. Return for test stand vibration check of engine.	–	–

2-89. EGT LOW AT MILITARY POWER SETTING.

	NO	YES
a. Operate engine at MIL and proceed into AB. Is stabilized EGT in AB higher than MIL EGT?	b	c
b. Check cockpit EGT instrument accuracy. Refer to prargraphs 2-76 or 2-80H. Does cockpit instrument read within prescribed limits?	d	e
c. Inspect aircraft to engine throttle system. Is system rigged properly and within wear limits?	f	g
d. Replace cockpit EGT instrument.	–	–
e. Perform a complete Jetcal analysis of thermocouple system to include indicating and engine control circuits. Refer to paragraph 2-73 or 2-80A. Is system within limits?	h	i
f. Replace worn parts and/or rerig as necessary.	–	–
g. Check nozzle area control throttle loop rigging. Is system secure and properly rigged?	j	k
h. Replace faulty part(s).	–	–
i. Adjust EGT at amplifier. Refer to paragraph 4-135. Does this correct problem?	l	m
j. Rerig throttle system.	–	–
k. Check exhaust nozzle feedback and actuator rigging. Are systems rigged properly?	n	o
l. Replace temperature amplifier.	–	–
m. Return engine to service.	–	–
n. Rerig feedback or actuators to proper settings.	–	–
o. Replace nozzle area control.	–	–

2-90. EGT HIGH AT MILITARY POWER SETTING.

	NO	YES
a. Perform a complete Jetcal analysis of thermocouple system to include indicating and engine control circuits. Refer to paragraph 2-73 or 2-80A. Is indicating system reading correct?	b	c
b. Replace faulty parts as necessary.	–	–
c. Did overtemperature exceed serviceable limits?	d	e
d. During Jetcal check did engine control circuits read within limits?	f	g
e. Return engine to Intermediate Maintenance for corrective action.	–	–
f. Replace faulty parts as necessary.	–	–
g. Adjust EGT at temperature amplifier. Refer to paragraph 4-135. Does this correct problem?	h	i
h. Slave in known good temperature amplifier. Is problem corrected?	j	k
i. Return engine to service.	–	–
j. Replace nozzle area control.	–	–
k. Replace temperature amplifier.	–	–

2-91. ENGINE SLOW ACCELERATING IDLE TO MILITARY POWER.

	NO	YES
a. Does compressor or turbine have FOD?	b	c
b. Is specific gravity adjustment on main fuel control set at specific gravity of fuel being used?	d	e
c. Rework or replace parts as necessary.	–	–
d. Set fuel control specific gravity at proper value.	–	–
e. CDP line to main fuel control may be leaking at either end. Are fittings loose?	f	g
f. Engine air may be leaking excessively. Inspect bleed air ducting and both check valves for leakage. Is leakage present?	h	i
g. Torque fittings or replace washers as necessary.	–	–

	NO	YES
h. Are variable vanes tracking properly and is running null within limits?	j	k
i. Correct malfunctions.	–	–
j. Rerig variable vanes or replace CIT sensor as required.	–	–
k. Is exhaust nozzle rigged properly and is feedback system operating freely?	–	–
l. Rerig nozzle. Replace parts and/or lubricate feedback system as necessary.	–	–
m. If slow acceleration is between 85 percent and MIL, be suspicious of temperature amplifier and control alternator. Does slave temperature amplifier correct problem?	n	o
n. Are high and low pressure main fuel filters contaminated?	p	q
o. Replace temperature amplifier.	–	–
p. Replace main fuel control.	–	–
q. Clean or replace filter elements.	–	–

2-92. STARTING SPEED REACHED, BUT NO START – FUEL FLOW NORMAL.

	NO	YES
a. Are both spark plugs inoperative?	b	c
b. On inoperative system check for operation of ignition unit. Does unit hum?	d	e
c. Energize opposite engine ignition system. Does opposite system operate?	f	g
d. Measure 28 Vdc at input. Is voltage correct?	h	i

WARNING

To prevent personnel injury, do not touch plug while energizing ignition unit.

	NO	YES
e. Remove spark plug from combustor, reconnect lead and ground on engine. Energize engine ignition, check plug for firing. Does plug fire?	j	k
f. Troubleshoot essential 28 Vdc bus and associated circuit.	–	–
g. Troubleshoot left or right ignition 28 Vdc bus and associated circuit.	–	–
h. Troubleshoot aircraft/engine wiring.	–	–
i. Replace ignition unit.	–	–
j. Replace spark plug. Does new plug correct problem?	l	m
k. Remove igniter fuel nozzle and inspect nozzle and combustion liner dome for carbon buildup. Is carbon present?	n	o
l. Replace lead.	–	–
m. Return engine to service.	–	–
n. Replace fuel nozzle.	–	–
o. Clean combustion liner and/or replace fuel nozzle.	–	–

2-93. AFTERBURNER IGNITER PLUG FAILS TO SPARK OR HAS WEAK SPARK AND/OR INCORRECT OR ERRATIC SPARK RATE WHEN SYSTEM IS ENERGIZED.

	NO	YF
a. Disconnect plug of afterburner ignition switch. Jumper pins C and A of plug. Energize system. Does system operate correctly?	b	c
b. Measure 115V, 400 Hz at pin F of engine disconnect plug 52P636R or 52P632L. Is voltage correct?	d	e
c. Replace afterburner ignition switch.	–	–
d. Troubleshoot aircraft electrical system.	–	–
e. Measure 115V, 400 Hz at pin B of plug to ignition unit. Is voltage correct?	f	g

	NO	YES
f. Check engine wiring.	–	–
g. Disconnect igniter plug lead from ignition unit and igniter plug. Measure continuity and resistance to ground of both flexible and rigid igniter plug leads. When measuring continuity of flexible lead, flex lead to reveal possible intermittent open. Do not flex rigid lead. Resistance to ground should be infinity. Are checks satisfactory?	h	i
h. Replace defective lead.	–	–
i. Rigid lead or lead portion of igniter plug may be breaking down under high voltage. Perform high voltage breakdown check as follows: Increase dielectric strength of igniter plug gap by saturating plug with fuel. (Use battery syringe or equivalent filled with fuel).		

WARNING

To prevent personnel injury, observe igniter plug from safe distance.

	NO	YES
Initiate ignition and observe igniter plug. Sparking should be immediate and consistent. If sparking is delayed or inconsistent, allow system to operate for at least two minutes. Check for hot spots in lead, particularly at bends or connectors, by running hand along lead. Are hot spots present?	j	k
j. Replace igniter plug. Does afterburner ignition system operate satisfactorily with new plug?	l	m
k. Replace defective lead and/or igniter plug.	–	–
l. Replace ignition unit.	–	–
m. Return engine to service.	–	–

2-94. ENGINE SURGES OR IS ERRATIC IN AFTERBURNER ONLY.

	NO	YES
a. Check exhaust nozzle feedback for smooth operation. Does problem exist?	b	c
b. Return to service.	–	–
c. Replace AB fuel control. Is surge still present?	d	e
d. Return to service.	–	–
e. Replace AB pressurizing valve.	–	–

2-95. EXCESSIVE RPM DROP OFF WHEN GOING INTO AFTERBURNER.

	NO	YES
a. Check specific gravity settings on main and AB fuel controls. Are adjustments set for fuel being used?	b	c
b. Set specific gravity for fuel being used.	–	–
c. Check for CDP line security at MFC and compressor rear frame tap. Are B nuts secure?	d	f
d. Torque B nuts 130 to 150 inch-pounds and lockwire.	–	–
e. Deleted.		
f. Troubleshoot EGT and exhaust nozzle system. Refer to paragraphs 2-75 and 2-98 or 2-80A.	–	–
g. Deleted.		

2-96. EGT HIGH IN MAXIMUM AFTERBURNER ONLY.

	NO	YES
a. Check exhaust nozzle feedback rigging. Is feedback rigged correctly?	b	c
b. Rerig nozzle feedback. Assure all ports are lubricated properly and do not exhibit excessive wear.	–	–
c. Extend exhaust nozzle to full open position using pressurizing unit 1C3569G. Measure and record nozzle diameter using 1C2754G. Is the maximum nozzle area obtained?	d	e
d. Return engine to intermediate maintenance for corrective action.	–	–
e. Replace afterburner fuel control. Does this correct the problem?	f	g

	NO	YES
f. Check aircraft bleed air ducting for leakage.	–	–
g. Return engine to service.	–	–

2-97. EGT AND/OR NOZZLE FLUCTUATES ON TEMPERATURE LIMITING.

CAUTION

With temperature system plugs disconnected, do not exceed EGT limits. Possible damage to engine will occur.

	NO	YES
a. Disconnect control alternator plug and recheck engine at rated temperature. Is fluctuation still present?	b	c
b. Reconnect electrical plug. Slave in temperature amplifier. Is fluctuation still present?	d	e
c. Continue troubleshoot by referring to paragraph 2-75.	–	–
d. Replace temperature amplifier.	–	–
e. Replace nozzle area control.	–	–

2-98. EGT AND/OR EXHAUST NOZZLE UNSTABLE ON MECHANICAL SCHEDULE.

	NO	YES
a. Check cockpit instruments. Are any instruments faulty?	b	c
b. Does exhaust nozzle feedback system operate freely?	d	e
c. Replace instrument.	–	–
d. Lubricate and/or replace worn parts as necessary.	–	–
e. Does output piston from nozzle area control to pump lever arm move freely without engine running?	f	g
f. Replace parts as required.	–	–
g. Does nozzle cock or bind when it is pumped open or closed?	h	i
h. Are sheave wheel teeth at throttle input to nozzle area control fully engaged or torqued properly?	j	k
i. Isolate part causing binding; adjust or replace parts as required.	–	–
j. Rerig and replace damaged parts as necessary.	–	–
k. Install direct pressure reading gage (0 to 150 psi) at nozzle pump inlet. Is nozzle pump inlet pressure within limits?	l	m
l. Isolate which pressure relief valve is sticking (external relief valve or hydraulic relief valve in main lube and hydraulic pump). Replace parts as required.	–	–
m. Replace nozzle area control.	–	–

2-99. NOZZLE FAILS FULL OPEN OR FULL CLOSED.

CAUTION

With temperature system cable plugs disconnected, do not exceed EGT limits.

	NO	YES
a. Is exhaust nozzle feedback system functioning properly and intact?	b	c
b. Replace and rerig as required.	–	–
c. With engine shutdown cycle nozzle area control output shaft nozzle pump arm through full stroke of travel. Is any restriction or binding evident?	d	e
d. Pump exhaust nozzle open and closed. Is any binding or cocking evident in nozzle or actuators?	f	g
e. Isolate part causing binding, and replace parts as required.	–	–
f. Disconnect control alternator plug and recheck engine. Does nozzle follow mechanical schedule?	h	k

	NO	YES
g. Replace nozzle or actuator parts as necessary.	–	–
h. If nozzle goes open, stroke nozzle area control output shaft and nozzle pump arm with engine running to move nozzle. Does exhaust nozzle follow output shaft and pump lever movement?	i	j
i. Replace nozzle hydraulic pump.	-	–
j. Replace nozzle area control.	–	–
k. Reconnect cable plug (J3). Slave in temperature amplifier. Is problem corrected?	l	m
l. Use Jetcal to isolate problem in temperature limiting system. Refer to paragraph 2-73 or 2-80A	–	–
m. Replace temperature amplifier.	–	–

2-100. HIGH OIL CONSUMPTION - NO LEAKAGE EVIDENT.

	NO	YES
a. Motor engine to scavenge gearboxes, then recheck oil level. Is overfill evident?	b	c
b. Check past servicing records. Does engine have a history or high oil consumption?	d	e
c. This indicates leakage of lube or hydraulic static check valve. Replace parts as required. Refer to T O 2J-J79-46, Filter Shut-off Valve Replacement Procedures.	–	–
d. Drain transfer and rear gearboxes. Does total oil quantity drained exceed one quart?	f	g
e. Return engine to Intermediate Maintenance for corrective action.	–	–
f. Return engine to service and monitor oil service requirements.	–	–
g. Check gearbox scavenge pumps and screens. Clean and/or replace parts as required.	–	–

2-101. HIGH OR FLUCTUATING INDICATED OIL PRESSURE.

NOTE

During afterburner operation, oil pressure may increase slightly. This is a normal condition.

	NO	YES
a. Install differential pressure gage to oil pressure tap and to sump pressure line. Run engine and compare pressure reading of cockpit gage with reading of differential pressure gage. Do readings agree?	b	c
b. Troubleshoot and repair lube pressure indicating system.	–	–
c. Clean filters, flush system and run engine. If improvement in oil pressure is indicated, flush system again and rerun engine. If oil pressure still remains high, return engine to Intermediate Maintenance for repair.	–	–

2-102. LOW OR NO INDICATED OIL PRESSURE.

	NO	YES
a. Has oil tank been serviced properly?	b	c
b. Service oil tank and record quantity.	–	–
c. If oil pressure is zero, loosen fitting at main lube pump and motor engine. Does oil flow from pump?	d	e
d. Replace main lube pump, investigate CSD unit for failure. Flush system and clean filters. If engine has operated above IDLE for extended period replace nozzle pump.	–	–
e. Install differential pressure gage to oil pressure tap and to sump pressure line. (If differential pressure gage is not available, use two gages and algebraically subtract sump pressure from oil pressure.) Run engine and compare pressure reading of cockpit gage with reading of differential pressure gage. Do readings agree?	f	g
f. Troubleshoot and repair lube pressure indicating system. Refer to T O 1F-4C-2-11.	–	–
g. Flush system and run engine. If oil pressure is still low, replace main lube pump. If new pump fails to correct problem, return engine to Intermediate Maintenance.	–	–

2-103. OIL AND/OR VAPORS FROM FRAME STRUTS.

NOTE

During transient operation, vapor is acceptable at compressor rear frame 17th stage struts, and 7th stage leakage ports of turbine frame, provided vapor ceases within 30 seconds after reaching steady state.

	NO	YES
a. Are vapors present after 30 seconds at steady state?	b	c
b. Oil and/or vapors were residual. If there is no evidence of high oil consumption, return engine to service.	–	–
c. Return engine to Intermediate Maintenance for corrective action.	–	–

2-104. OIL SYSTEM OVERBOARD VENTING.

	NO	YES
a. Overservicing is most probably cause of overboard venting. Motor engine to scavenge gearboxes and check oil level. Was oil tank overserviced?	b	c
b. Return engine to Intermediate Maintenance for corrective action.	–	–
c. This indicates leakage of lube and hydraulic check valve. Replace parts as required.	–	–

2-105. SUSPECTED CSD INTERNAL FAILURE OR MORE THAN 14 PINTS REQUIRED TO SERVICE LUBRICATION SYSTEM AFTER FLIGHT.

	NO	YES
a. Inspect CSD filter with bright light and 5 power magnifying glass. Does filter evidence contamination?	b	c
b. Replace filter element if this inspection is being performed on scheduled basis in accordance with T.O.1F-4C-6 otherwise reinstall element.	–	–
c. Does filter contain any varnish like deposits or evidence contamination in excess of following: 6 or more particles 3/16 x 1/16 inch or 6 or more flakes of silver plating?	d	e
d. Flush CSD return line between CSD and filter. Clean CSD filter. Are metal particles present on magnetic clip detector or filter element?	f	g
e. Perform following:		
(1) Inspect magnetic chip detector on CSD. If chip detector is clean, proceed to step d. If chip detector evidences any contamination, return CSD to overhaul.		
(2) Determine if CSD filter is bypassing by performing a directional pressure check. If differential pressure exceeds 25 psi, it should be assumed that the filter has been bypassed. Is differential pressure less than 25 psi?	h	i
f. Return CSD to service.	–	–
g. Return CSD to overhaul.	–	–
h. Check engine scavenge oil filter. Does filter evidence contamination?	j	k
i. Replace filter element.	–	–
j. Inspect the following screens, magnetic chip detectors, and filters for contamination.		
(1) Main lube and hydraulic pump inlet pressure.		
(2) Main lube and hydraulic pump discharge filters.		
(3) Transfer gearbox scavenge pump inlet screen.		
(4) Transfer gearbox magnetic chip detector.		
(5) Rear gearbox scavenge pump inlet screens.		
(6) Nozzle pump magnetic chip detector.		
(7) Nozzle pump bidirectional filters.Are all above free from contamination?	l	m
k. Replace engine.	–	–
l. Clean and reinstall above listed screens, magnetic chip detectors, and filters. Drain oil tank, lines		

	NO	YES
between oil tank and lube and hydraulic pump inlet screens, and CSD supply line. Replenish with clean oil. Run engine (without CSD installed) at military power for 10 minutes and recheck screens, magnetic chip detectors, and filters, including scavenge filter. Are all of screens, magnetic chip detectors and filters free from contamination?	n	o
m. Install new CSD filter and reinstall above listed filters. Return engine to service.	–	–
n. Return engine to field level maintenance for further investigation.	–	–
o. Replace CSD filter. Return engine to service.	–	–

2-106. MILITARY SPEED OUT OF LIMITS.

NOTE

At compressor inlet temperatures (CIT) below 4.4°C top speed will be below 100 percent.

	NO	YES
a. Check engine speed with Jetcal. Refer to paragraph 2-77 or 2-80J. Does RPM indicated on cockpit indicator agree with Jetcal?	b	c
b. Correct indicating system.	–	–
c. Is engine speed high?	d	e
d. Check aircraft to engine throttle linkage. Is linkage properly rigged?	f	g
e. Check variable vane rigging. Are variable vanes tracking on correct schedule?	h	i
f. Rig aircraft to engine linkage.	–	–
g. Is CDP line to main fuel control secure at both ends?	j	e
h. Replace CIT Censor. Are variable vanes tracking on correct schedule?	k	l
i. Adjust top speed in main fuel control. Refer to paragraph 4-134. Is speed correct?	k	l
j. Tighten fittings.	–	–
k. Replace main fuel control.	–	–
l. Return engine to service.	–	–
m. Replace CIT sensor.	–	–

2-107. RPM FLUCTUATES AT HIGH POWER.

NOTE

Retard throttle to lower power setting where exhaust nozzle is on mechanical schedule.

	NO	YES
a. Does RPM still fluctuate?	b	c
b. This is exhaust nozzle system problem. Refer to paragraph 2-98.	–	–
c. Does exhaust nozzle fluctuate?	d	e
d. Perform Engine Control Box Wear Check. Is control box wear excessive?	f	g
e. This is exhaust nozzle system problem. Refer to paragraph 2-98.	–	–
f. Replace main fuel control.	–	–
g. Replace engine control box.	–	–

2-108. HOT START.

	NO	YES
a. Were EGT limits exceeded?	b	c
b. Were aircraft flaps down?	d	e
c. Reject engine and perform applicable inspection.	–	–
d. Is bleed air check valve installed properly and functioning?	f	g
e. Retract flaps and attempt start.	–	–
f. Replace bleed air check valve.	–	–
g. Was fuel flow normal?	h	i
h. Replace main fuel control.	–	–
i. Low output ground cart or start cartridges.	–	–

2-109. NO OR SLOW ACCELERATION TO IDLE.

	NO	YES
a. Was EGT high during start?	e	b
b. Are flaps UP?	c	d
c. Retract flaps and reattempt start.	–	–
d. Troubleshoot boundary layer control system. Refer to T.O.1F-4C-2-7.	–	–
e. Was fuel draining from door 92 during start?	g	f
f. Replace pressurizing and drain valve.	–	–
g. Was fuel flow low during start?	h	k
h. Perform following variable vane checks:		
(1) Connect flight line troubleshooting tester to engine. Refer to T.O.33D4-6-165-11.		
(2) Start engine and advance throttle to MIL then return to IDLE while checking variable vane scheduling. See figure 2-19.		
(3) Do variable vanes follow schedule?	j	i
i. Replace main fuel control.	–	–
j. Rig variable vanes.	–	–
k. Is main fuel control at idle when throttle lever is at IDLE?	l	m
l. Rig throttle.	–	–
m. Is CDP line to main fuel control secure at both ends?	n	o
n. Tighten fittings.	–	–
o. Replace main fuel control.	–	–

2-110. NO OR SLOW ENGINE ROTATION - PNEUMATIC START.

	NO	YES
a. Was starter rotation indicated by starter turbine noise?	b	d
b. If engine was at operating temperature and not properly cooled, allow one hour cooling period. Will engine rotate freely with no rubbing or binding when hand turning compressor?	c	d
c. Replace engine.	–	–
d. Replace starter.	–	–

2-111. NO OR SLOW ENGINE ROTATION - CARTRIDGE START.

	NO	YES
a. Did cartridge fire?	c	b
b. Did engine rotate?	f	i
c. Is 28 VDC available at pin A of 5P602 on starter?	h	d
d. Does continuity exist between breech cap pin A and ignition contact?	f	e
e. Does contpinuity exist between breech cap pin B and ground clip?	f	g
f. Replace starter. Refer to paragraph 3-58.	-	-
g. Replace cartridge and reattempt start. Refer to paragraphs 2-27 and 2-31.	-	-
h. Troubleshoot wiring. See figure 3-1.	-	-
i. If engine was at operating temperature and not properly cooled, allow one hour cooling period. Will engine rotate freely with no rubbing or binding when hand turning compressor?	j	g
j. Replace engine.	-	-

2-112. VARIABLE VANES DO NOT FOLLOW SCHEDULE OR ARE OTHERWISE UNSTABLE.

	NO	YES
a. Is CIT sensor leaking fluid from capillary tubes, or are they otherwise damaged?	b	c

NOTE

Below 63% vanes should be fully closed; above 95% vanes should be fully open.

	NO	YES
b. Check variable vane schedule. Is vane position too high or too low for CIT?	f	d
c. Replace CIT sensor.	-	-
d. Is variable vane feedback linkage properly rigged?	e	f
e. Rerig as necessary.	-	-
f. Instrument actuator head and rod end pressures. During steady state operation, head and rod end pressures should be approximately same (about 300 psi). If neither pressure is unusually high, check for binding in system. If vane movement is erratic, check for binding in feedback cable. Are checks satisfactory?	g	h
g. Replace defective actuator or correct source of binding.	-	-
h. Replace main fuel control.	-	-

2-113. NO EGT INDICATION ON INVERTER POWER63-7598 THRU 64-928.

	NO	YES
a. Perform following steps:		
(1) Assure external electrical power is not applied to aircraft.		
(2) Remove electrical connector 52P327C from no. 3 misc relay panel 52Z327.		
(3) Apply external electrical power.		
(4) Using AN/PSM-6, check for 115 Vac between 52P327C pins C and W. Does 115 Vac exist?	b	f
b. Perform following steps:		
(1) Remove external electrical power.		
(2) Remove electrical connector 4P319A from no. 2 circuit breaker panel 4Z319.		
(3) Apply external electrical power.		
(4) Using AN/PSM-6, check for 115 Vac between 4J319A pin J and aircraft structure. Does 115 Vac exist?	c	d
c. Remove external electrical power and repair defective no. 2 circuit breaker panel 4Z319.Refer to T.O.1F-4C-2-13.	-	-

	NO	YES
d. Perform following steps:		
(1) Assure external electrical power is not applied to aircraft.		
(2) Using AN/PSM-6, check for continuity between 4P319A pins J and 52P327C pin C. Does continuity exist?	e	f
e. Repair or replace defective wiring. Refer to T O 1F-4C-2-23.	–	–
f. Repair or replace defective no. 3 misc relay panel 52Z327.	–	–

2-114. IDLE RPM OUT OF LIMITS.

NOTE

Idle speed limits 64 to 66 percent RPM.

	NO	YES
a. Perform Airframe Power Plant Control System Rigging Check. Is system properly rigged?	b	c
b. Rerig Airframe Power Plant Control System. If difficulty is experienced when rigging the system because of slop in system, perform Engine Control Box Wear Check.	–	–
c. Check engine speed with Jetcal. Refer to paragraph 4-133. Is RPM low?	d	g
d. Does Jetcal agree with cockpit tachometer indicator?	e	f
e. Perform tachometer system check. Refer to paragraph 2-77 or 2-80J.	–	–
f. If idle RPM is above maximum limit, check for possible high compressor inlet temperature because of a closed auxiliary air door or exhaust gas from another aircraft. If a utility hydraulic system failure occurs in flight or during landing roll, air loads on auxiliary air doors may cause doors to close or remain closed with landing gear extended causing hot air recirculation and thus creating a condition wherein RPM will not decrease to IDLE when throttles are in IDLE. Perform Auxiliary Air Door Operational Check. Refer to T.O.1F-4C-2-9. Are auxiliary air doors functioning properly?	h	i
g. Operate throttle through IDLE range noting fuel flow increase. Check main fuel control adjustment. If IDLE speed cannot be adjusted within limits, replace main fuel control. Refer to paragraph 5-18.	–	–
h. Troubleshoot auxiliary air system. Refer to TO 1F-4C-2-9.	–	–
i. Adjust main fuel control. Refer to paragraph 4-133. If IDLE speed cannot be adjusted within limits, replace main fuel control.	–	–

2-115. AIRFRAME POWER PLANT CONTROL SYSTEM FRICTION IS EXCESSIVE.

	NO	YES
a. Perform an Airframe Engine Control System Friction Check on the left and right system. Is friction excessive in both systems?	b	c
b. Perform an Engine Control Box Universal Joint Friction Check. Is friction in excess of 9.0 pounds?	d	e
c. Through door 9L, disconnect telescopic unit rod ends from forward cockpit throttle levers. Do not disturb telescopic unit or rod end adjustment. Remove center engine control panel. Position friction lever full aft and check amount of force required, at hand grip, to move each throttle lever between IDLE and MIL. Is force required in excess of 0.5 pounds?	h	i
d. Remove door 9L and disconnect telescopic unit from forward cockpit throttle lever. Do not disturb telescopic unit or rod end adjustment. Remove center engine control panel, position friction lever full aft and check the amount of force required, at hand grip, to move throttle lever between IDLE and MIL. If lever is rubbing engine control panel, loosen conduit nut on forward side of engine control box and check conduit for alignment. Tighten nut and check friction. Is force required in excess of 0.5 pounds?	f	g
e. Replace engine control box.	–	–
f. Remove the throttle panel and center control panel from aft cockpit left console and disconnect telescopic unit from throttle lever. Check amount of force required, at hand grip, to move throttle lever when lever is positioned nearly vertical. Is force required in excess of 0.25 pounds?	k	l
g. Remove quadrant and inspect lower lever bushing and quadrant shaft for galling. Replace lower lever and/or quadrant shaft.	–	–
h. Remove throttle panel and central control panel aft cockpit left console and disconnect telescopic units		

	NO	YES
from aft cockpit/throttle levers. Check amount of force required, at hand grip, to move each throttle lever when lever is positioned nearly vertical. Is force required in excess of 0.25 pounds?	k	j
i. Remove forward cockpit throttle quadrant assembly, inspect and adjust friction mechanism.	–	–
j. Remove aft cockpit throttle quadrant. Disassemble quadrant and check condition of bearings in each lever. Replace bearing assemblies.	–	–
k. Check engine control box friction as follows:		
(1) Pull teleflex cable forward until it becomes disengaged from engine control box.		
(2) With engine control box torque shaft disconnected from main fuel control crossover shaft, support torque shaft in a horizontal position.		
(3) Insert a short section of teleflex cable into control box.		
(4) Check amount of force required to move cable or amount of torque required to rotate shaft. The force required to move cable should not exceed 0.85 pounds or torque required to rotate shaft should not exceed 1.75 inch pounds.		
(5) Is control box friction in excess of above specified limits?	m	n
l. Remove aft cockpit throttle quadrant. Disassemble quadrant and check condition of lever bearings. Replace bearing assembly.	–	–
m. Remove teleflex cable entirely. Insert a section of teleflex cable into aft cockpit control box and check amount of force required to move cable and control box wheel through 12 inches of cable travel. Is force required in excess of 0.85 pounds?	o	p

CAUTION

Do not attempt to lubricate engine control box or aft cockpit box. Lubrication may induce friction.

	NO	YES
n. Replace engine control box.	–	–
o. Inspect teleflex conduit for kinks. Replace all damaged conduit, install and adjust teleflex cable.	–	–
p. Replace aft cockpit control box.	–	–

NOTE

Dirt in airframe power plant control system will cause high system friction, therefore, care should be exercised to prevent dirt or any foreign material from entering system. If dirt is suspected of being cause of high system friction, clean and lubricate teleflex cables. Run long cable completely through entire system and down through aft cockpit control box. Again clean and lubricate cable. Reinstall all cables and again check system friction.

2-116. STARTING SPEED REACHED - NO START - NO FUEL FLOW.

NOTE

If engine fails to start when attempting a start without use of external electrical power, assure battery charge is adequate and battery relay is energizing when ENGINE MASTER switch is ON and is applying power to essential 28Vdc bus. This can be verified by placing INSTR PANEL EMERG FLOOD switch in BRT position. Bright flood lights will indicate good battery.

	NO	YES
a. Connect external electrical power to aircraft, place ENGINE MASTER switch ON and position throttle at IDLE. Observe engine manifold shutoff valve operation through door 22. Does valve open?	b	c
b. Actuate fuel boost pump check switch and observe engine manifold shutoff valve operation. Does valve open?	h	i
c. **Perform Airframe Power Plant Control System Rigging Check — Engines Off. Refer to paragraph 2—53. Is system connected and properly rigged?**	d	e
d. Connect and/or rerig system. Refer to paragraph 4–115.	–	–

	NO	YES
e. Is engine main fuel pump discharge pressure at least 100 psig above aircraft boost puressure at 10 percent RPM?	f	g
f. Possible main fuel pump failure. Inspect for drive rotation and replace main fuel pump.		–
g. Replace main fuel control. Refer to paragraph 5-23.	–	–
h. Check for 28 Vdc to pin A valve plug 7P401 or 7P402 with applicable boost pump check switch in CHECK position. Does power exist at pin A?	j	k
i. Remove inboard engine control panel. Place applicable throttle at IDLE and check for 28 Vdc at pin U (right) or pin V (left) on panel disconnect plug 52P208. Does power exist?	l	m
j. Check wiring from pin A through boost pump check switches into main fuel control circuit breaker.	–	–
k. Replace engine manifold shutoff valve. Refer to paragraph 4-79.	–	–
l. Replace applicable throttle cutoff switch and/or actuator.	–	–
m. Place ENGINE MASTER switch ON and check for continuity between pins V and W (left) or pins U and T (right) on panel connector. Does continuity exist?	n	o
n. Replace ENGINE MASTER switch.	–	–
o. Check for continuity between pin W (left) or T (right) on inboard engine control panel disconnect and pin P (left) or S (right) on fuel panel disconnect.	–	–

2-117. STARTING SPEED REACHED - NO START - LOW FUEL FLOW.

NOTE

Starting fuel flow should be checked at approximately 10 to 12 percent RPM.

	NO	YES
a. Perform Airframe Power Plant Control System Rigging Check — Engines Off. Refer to paragraph 2—53. Is system out of rig?	b	c
b. Check aircraft fuel boost pump pressure. Is pressure between 25 to 35 psig?	d	e
c. Rerig system.	–	–
d. Perform trouble analysis on fuel boost pump. Refer to T.O.1F-4C-2-10.	–	–
e. Check engine main fuel pump discharge pressure. Is pressure at least 100 psig above boost pressure at 10 percent RPM?	f	g
f. Replace engine main fuel pump.	–	–
g. Replace main fuel control.	–	–

2-118. NIBBLING OR CONTINUOUS AFTERBURNER OPERATION WITH THROTTLE IN MIL.

	NO	YES
a. Does afterburner operation occur when throttle is advanced slowly to MIL?	b	d
b. Perform Engine Control Box Wear Check. Refer to paragraph 2-56. Is control box wear excessive?	d	c
c. Replace engine control box.	–	–
d. Perform Airframe Power Plant Control System Rigging Check. Refer to paragraph 2—53 or 2—54. Is system out of rig?	f	e
e. Rerig system.	–	–
f. Observe torque booster. Is torque booster motoring?	h	g
g. Replace torque booster.	–	–
h. Monitor AB on off signal between main fuel control and AB fuel pump with engine operating at MIL. Monitor reference pressure at AB fuel pump. Is AB on off signal pressure more than 20 psi above reference pressure?	i	j
i. Replace AB fuel pump.	–	–
j. Replace main fuel control.	–	–

2-119. IDLE INSTABILITY.

NOTE

Following procedure assumes speed instability exists at IDLE only. If instability is indicated at other speeds it may be instrument or indication system. Confirm with fuel flow and EGT.

		NO	YES
a.	Perform Engine Control Box Wear Check. Is control box wear excessive?	b	c
b.	Is torque booster motoring?	d	e
c.	Remove control box and replace.	–	–
d.	Does aircraft boost pressure fluctuate widely?	f	g
e.	Replace torque booster.	–	–
f.	Replace pressurizing and drain valve. Does this correct problem?	h	j
g.	Perform trouble analysis on fuel boost pumps. Refer to T.O.1F-4C-2-10.	–	–
h.	Replace main fuel control.	–	–
i.	Return engine to service.	–	–

2-120. NO POSITIVE FUEL SHUTOFF WHEN THROTTLE IS CHOPPED TO OFF.

		NO	YES
a.	With external electrical power connected, does fuel flow cease when ENGINE MASTER switch is OFF?	b	c
b.	With ENGINE MASTER switch OFF and throttle at IDLE, check for 28Vdc at pin B on engine manifold shutoff valve plug 7P401 (right) or 7P402 (left). Does power exist at pin B?	d	e
c.	Disconnect external electrical power. Remove center and inboard engine control panels. With throttle OFF, if inboard engine control panel bundle plug is not disconnected, place ENGINE MASTER switch ON. Check for continuity between terminals 20/13 and 17 (right engine) and 20/13 and 14 (left engine) on terminal board 51TB205 on forward cockpit throttle quadrant. Does continuity exist?	f	g
d.	With ENGINE MASTER switch OFF and throttle at IDLE, check continuity from main fuel control circuit breaker to pin B on shutoff valve plug. Replace defective wire or switch and proceed to step g.	–	–
e.	Replace engine manifold shutoff valve and proceed to step g.	–	–
f.	Is throttle cutoff switch properly adjusted?	h	i
g.	Perform Airframe Power Plant Control System Rigging Check and assure main fuel control is off when throttle is OFF. Is system out of rig?	j	k
h.	Adjust throttle cutoff switch and proceed to step g.	–	–
i.	Replace throttle cutoff switch and then proceed to step g	–	–
j.	Replace main fuel control. Refer to paragraph 5-23.	–	–
k.	Rerig system. Refer to paragraph 4-115.	–	–

2-121. ENGINE STALLS OR FLAMES OUT DURING DECELERATION.

NOTE

Excessive compressor corrosion may induce engine stall.

		NO	YES
a.	Does engine have compressor or turbine FOD?	b	c
b.	Is aircraft to engine throttle system rigged properly?	d	e
c.	Rework or replace parts as necessary.	–	–
d.	Rerig as required.	–	–
e.	Are aircraft throttle linkages and/or engine control box worn?	f	g
f.	Is torque booster to engine throttle loop system rigged correctly?	h	i

	NO	YES
g. Replace worn parts.	–	–
h. Rerig engine throttle loop system.	–	–
i. Are variable vanes tracking to schedule?	j	k
j. Rerig variable vanes to schedule or replace CIT sensor as required.	–	–
k. Is aircraft ramp and bellmouth operating properly? Refer to T.O.1F-4C-2-9.	l	m
l. Correct malfunction.	–	–
m. Replace main fuel control.	–	–

SECTION III

START AND IGNITION SYSTEMS

DESCRIPTION

3-1. **SYSTEM DESCRIPTION.** See figure 3-1.

3-2. The J79 engine starting system uses a cartridge/pneumatic type starter at the 6 o'clock position on the engine gearbox pad. The starter installation is of neutral configuration; that is, the method of installation and its installed appearance are identical for either left or right engines. The design of the starter permits engine starts to be initiated by either of two methods:

a. Cartridge mode – using gas generated by a MXU-4A/A solid propellant cartridge.

b. Pneumatic mode – using compressed air supplied by a compressor unit of the M32A-60 type or equivalent.

3-3. The starter is accessible through doors 81 L and R and 82 L and R. Doors 81R and door 140 provide access to the cartridge breech for cartridge loading. The necessary connections for pneumatic starting are made through doors 138 and 139. Doors 78 and 80 provide a common exit for both cartridge and pneumatic mode starting exhaust.

3-4. The ignition systems comprise three separate circuits that are powered by two ignition exciter units, one of which is a dual purpose unit. All three circuits are independent in operation except that the No. 1 and No. 2 main circuits operate simultaneously with the actuation of a single aircraft switch. The afterburner circuit is mounted within the No. 1 main exciter unit and is operated by a fuel pressure signal.

3-5. **COMPONENT DESCRIPTION.**

3-6. The ignition system components are as follows:

a. No. 1 ignition exciter unit (dual purpose)

b. No. 2 ignition exciter unit

c. Main igniter plugs

d. Afterburner igniter plugs

e. Afterburner ignition switch

3-7. **NO. 1 IGNITION EXCITER UNIT.** The ignition unit changes the 28 volt dc aircraft power into periodic high energy electrical pulses necessary for main spark plug operation. It also changes the 115 volt 400 Hz ac aircraft power into periodic high energy electrical pulses for afterburner igniter plug operation.

3-8. The ignition unit is a capacitor discharge assembly that houses two low voltage circuits, one for intermittent use for main igniter plug operation and the other for continuous use for afterburner igniter plug operation. The unit is at the 4 o'clock position on the compressor rear casing.

3-9. **NO. 2 IGNITION EXCITER UNIT.** The ignition unit increases the 28 volt dc aircraft power into periodic high energy electrical pulses necessary for main igniter plug operation. This unit operates in conjunction with the main circuit of the No. 1 ignition unit.

3-10. The ignition unit houses a capacitor discharge intermittent operating circuit for main igniter plug operation. The unit is at the 4 o'clock position on the compressor rear casing.

3-11. **MAIN IGNITER PLUG.** The main igniter plug produces the spark that ignites the fuel air mixture in the combustion section for engine operation.

3-12. The igniter plugs of the main ignition subsystem are low voltage, shunted surface gap type plugs. They are mounted in bosses in the outer combustion casing; one plug projects into the No. 4 combustion liner, and the other plug projects into the No. 5 combustion liner.

3-13. **AFTERBURNER IGNITION SWITCH.** The afterburner ignition switch allows the flow of current from an aircraft power source to the afterburner ignition circuit of the ignition unit and to the hydraulic fuel transfer pump control relay during afterburner operation.

3-14. The afterburner ignition switch is a pressure differential sensing switch, located in the afterburner on-off signal line from the main fuel control to the afterburner fuel pump inlet valve. A set of contacts within the switch closes when the pressure of the on-off signal exceeds reference pressure by a fixed amount.

3-15. See figure 3-1. When on-off signal pressure is applied, the afterburner switch contacts close and current flows from an aircraft power source to the afterburner ignition circuit of the ignition unit and the hydraulic fuel transfer pump control relay during afterburner operation.

3-16. **AFTERBURNER IGNITER PLUG.** The afterburner igniter plug produces the spark that ignites the fuel air mixture in the torch igniter for afterburner operation. The igniter plug is a low voltage, shunted surface gap type plug. It is within the torch igniter, which is mounted at the 6 o'clock position inside the tailpipe.

Table 3-1. Leading Particulars

NO. 1 IGNITION EXCITER UNIT	
MAIN IGNITION	
Input voltage	14-30 Vdc
Input current	3.0 amps (max.)
Spark rate	1 to 10 sparks per second
Duty cycle	2 min. on 3 min. off 2 min. on 23 min. off
Stored energy	4 joules
Output voltage	2650 to 3500 Vdc
AB IGNITION	
Input voltage	90-120 Vac at 350-500

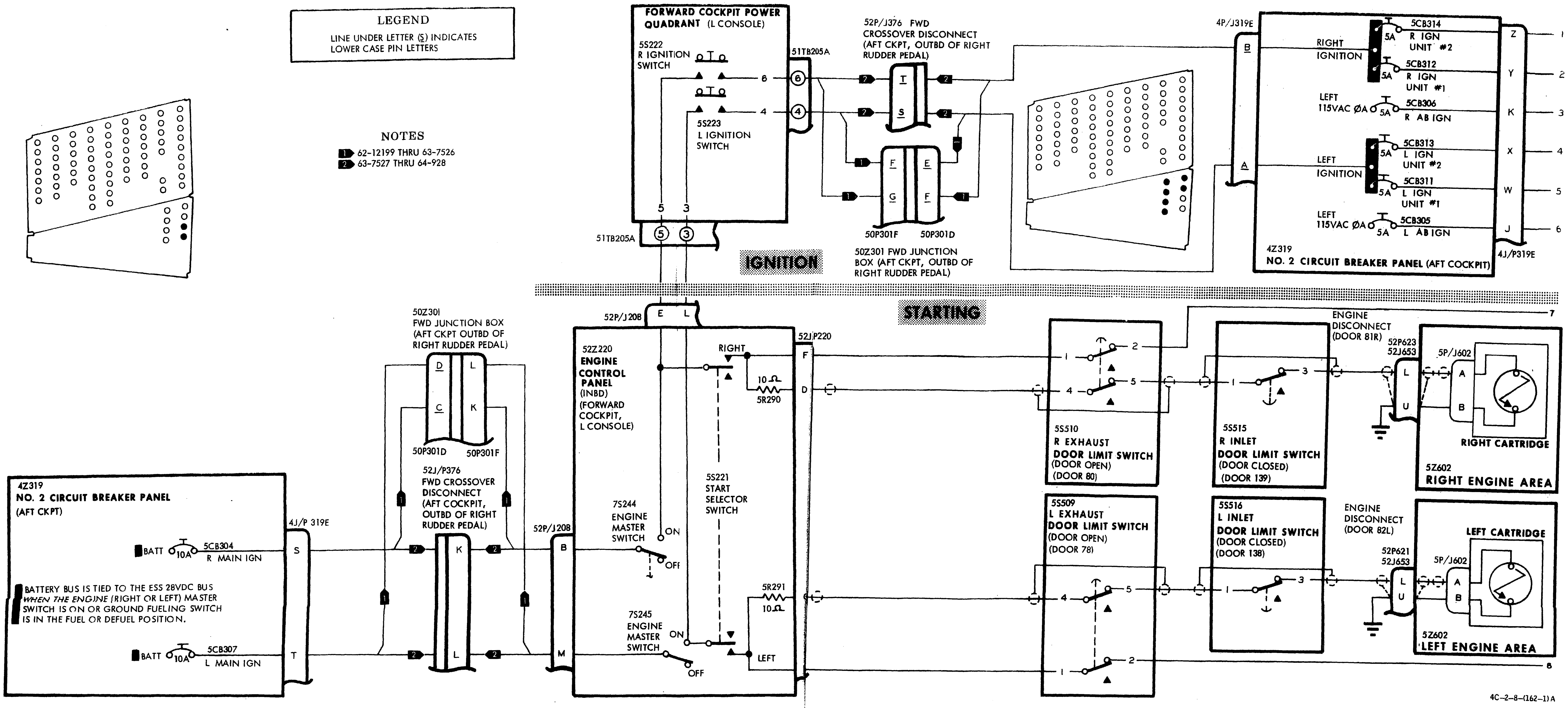


Figure 3-1. Start and Ignition System Schematic (Sheet 1 of 2)

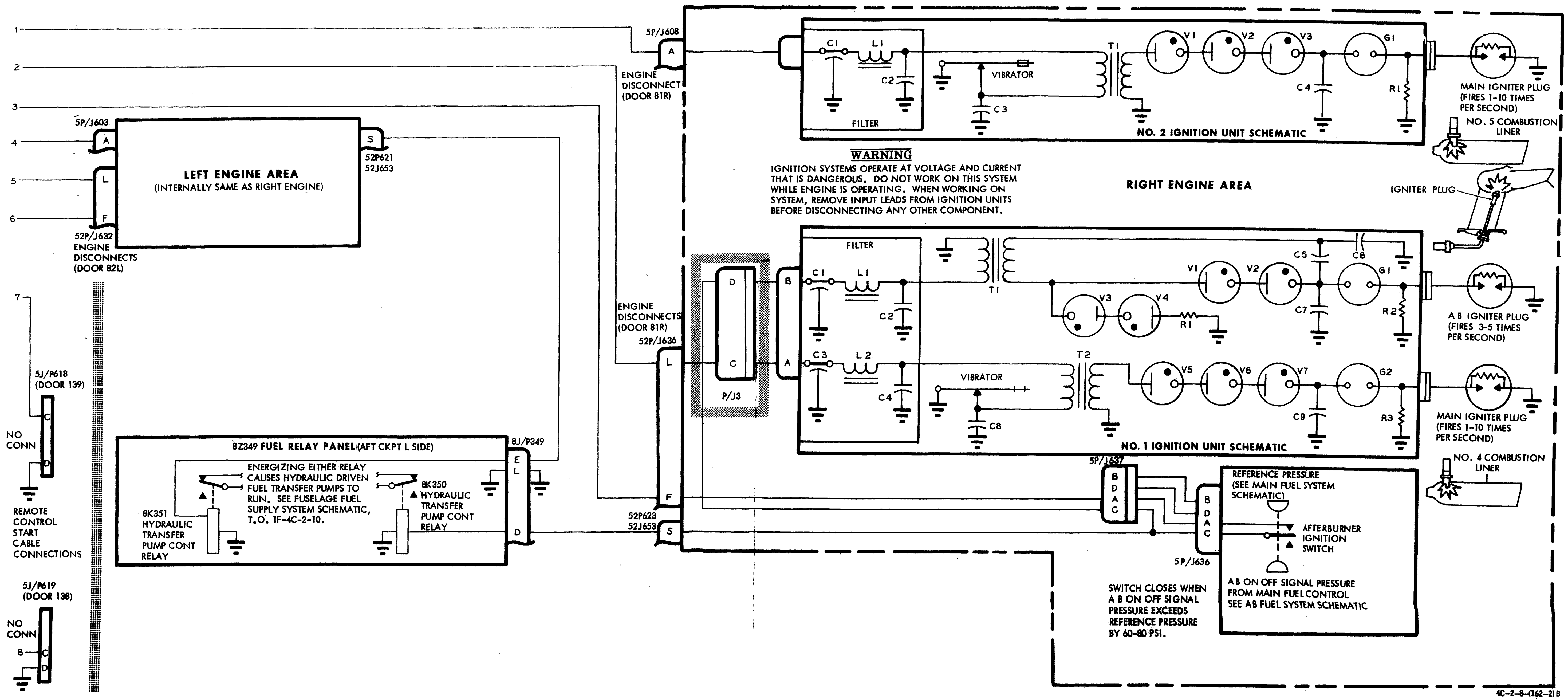


Figure 3-1. Start and Ignition System Schematic (Sheet 2 of 2)

Figure 3-1.

Table 3-1. Leading Particulars

	Hz
Input current	0.5 amps (max.)
Spark rate	4.0 ±1.20 sparks per second
Duty cycle	Continuous
Stored energy	2 joules
Output voltage	2650–3500 Vdc
NO. 2 MAIN IGNITION EXCITER UNIT	
Input voltage	14–30 Vdc
Input current	3.0 amps (max.)
Spark rate	1 to 10 sparks per second
Duty cycle	2 min. on 3 min. off 2 min. on 23 min. off
Stored energy	4.0 – 4.6 joules
Output voltage	2650 to 3500 Vdc

OPERATION

3-17. SEQUENCE OF OPERATION.

3-18. **STARTER.** See figure 3-1.

3-19. **Cartridge Gas Pressure Regulating and Over Pressure Relief Valve.** This valve is incorporated in the starter unit to maintain the pressure of the gas within the cartridge at the desired pressure. This valve ports hot gas directly through the turbine, bypassing the hot gas nozzle as the pressure rises above the preset maximum. It also provides over pressure relief in case of erratic cartridge burning. It has consistent actuation and automatic resetting.

3-20. **Aerodynamic Braking.** Whether starting is by cartridge or compressed air, some opposing force is required to keep turbine speed within safe limits. This opposing force is provided by the aerodynamic braking fan. The fan is connected directly to the turbine shaft. It is supplied with air from the aircraft nacelle and its output is carried off by an exhaust ring concentric with and within the turbine exhaust ring. Hot gas (or compressed air) exhaust and aerodynamic braking fan output are kept separate up to the overboard exhaust connector. At this point they emerge, the cool air from the fan cooling the hot exhaust gas.

3-21. **Intermediate Spur Gearshaft.** The intermediate spur gearshaft is part of a two stage reduction which reduces the maximum turbine speed of 66,800 RPM to an output of approximately 4100 RPM.

3-22. **AUTOMATIC CONTROLS AND LIMIT DEVICES.**

3-23. **Pawl and Ratchet Type Clutch (Airesearch).** The pawl and ratchet type clutch, drive shaft and output shaft are contained within the gear housing assembly. After the engine starts, the starter output shaft and drive shaft are rotated by the engine at a speed faster than starter rotation. This condition causes the spring loaded pawls to begin to disengage. Once sufficient engine speed has been attained, centrifugal force completely releases the pawls from the starter jaw. The starter output and drive shaft continue to be driven by the engine, but the released pawls allow the turbine wheel and reduction gear train to come to rest.

3-24. **Overrunning Sprag Clutch (Sundstrand).** The clutch is in the output area between the gear shaft on which the final drive gear is located and the output spline. It is sprag type, one way, overrunning clutch. It prevents the engine, once operating under its own power, from driving the starter, thereby eliminating the possibility of driving the turbine rotor at a speed above its safe limit. The nature of a sprag clutch is such that it can transmit torque in only one direction, that is, the driving member, operating through the clutch, delivers full torque to the driven member, but the driven member cannot become the driver (even though revolving in the same direction) and transmit torque back into the original driver. Any tendency for it to do so would disengage the clutch. When the engine has started and the starter has finished its cycle and stopped, only the output spline and the outer (driven) part of the clutch is revolving. The balance of the starter is at rest.

3-25. **Overspeed Disengagement Mechanism.** In case of malfunction or lock up of the overrunning output clutch, the engine, without other provision, drives the starter up to a speed above the design burst RPM of the turbine rotor. To prevent this, the starter is provided with a disengaging output spline shaft assembly. This assembly consists of two spring loaded splined sections held together by a tension bolt. A series of ratchet teeth interlock the mating sections of the spline. If internal failure causes the engine to exert excessive torque on the shaft, the ratchet teeth tend to separate the two shaft sections. The separating force is sufficient to shear the tension bolt, completely disengaging the starter. Both the tension bolt and shaft shear disengage the starter if start up torque exceeds the shaft shear section design limits.

3-26. **Containment Clamp.** If both the clutch and the overspeed disengagement mechanism fail to operate and the turbine is driven beyond burst RPM by the aircraft engine, the containment clamp provides additional strength to the starter turbine area preventing damage to the aircraft.

3-27. **Gearbox Vent.** A vent through the clutch and governor and output shaft eliminates internal pressure buildup. Centrifugal force caused by output rotation prevents oil leakage through the vent.

3-28. **STARTER LUBRICATION SYSTEM.** The starter is lubricated by a splash system. Oil slingers, attached to the clutch output race, pick up oil from the sump and distribute it throughout the interior of the starter as the output spline revolves. A catching cup construction in the housing, coupled with an oil lube arrangement, carries the oil into the overrunning clutch and other difficult to reach areas. Since the part to which the slingers are attached is constantly spinning (even after the starter has completed its cycle), starter lubrication continues as long as the aircraft engine is operating. The oil sump contains a magnetic plug to collect contamination.

3-29. **STARTER ELECTRICAL CIRCUIT.** See figure 3-1.

3-30. Inlet and Exhaust Door Limit Switches. Provided as part of the starter electrical hookup are four door limit switches, one for each exhaust door and one for each inlet door. Normal positions for the switches are: exhaust door closed, limit switch off or open circuit; inlet door closed, limit switch on or closed circuit.

3-31. **IGNITION.**

3-32. See figure 3-1. Even though the two circuits share a common housing they are independent in operation and power input. They are designated as main ignition circuit and afterburner ignition circuit throughout the following information.

3-33. **MAIN IGNITION CIRCUIT.** When the cockpit ignition switch is actuated, current flows from the 28 Vdc source through ground, the normally closed vibrator contacts, the primary winding of transformer T2, the filter, and back to the power supply.

3-34. Current flow through the primary winding causes the normally closed vibrator contacts to open. When the vibrator contacts open, current ceases to flow in the primary winding, allowing the vibrator contacts to close. This repeated vibrator action changes the dc current to pulsating dc current. Capacitor C8, in parallel with the vibrator contacts, prevents arcing across the points.

3-35. This pulsating dc voltage applied across the primary of transformer T2 induces an ac voltage in the secondary of T2. This ac voltage is of an increased potential due to the turns ratio of T2. When the bottom of T2 is negative, current flows from the secondary winding through ground to capacitor C9, through electron tube assemblies V7, V6, V5 and back to the secondary winding. When the top of T2 is negative, no current flows because rectifier tubes V5, V6 and V7 do not conduct. Each time the bottom of T2 is negative, the rectifier tubes conduct, and an additional charge is built up on capacitor C9.

3-36. When the charge on capacitor C9 reaches the breakdown voltage of gap G2, gap G2 is ionized and a small current flows from capacitor C9 through ground, the shunting surface of the igniter plug, gap G2 and back to capacitor C9. The current flow across the shunting surface of the igniter plug ionizes the air gap between the electrodes of the igniter plug. With gap G2 and the igniter plug ionized; a large current flows from capacitor C9 through ground, the spark plug, gap G2 and back to capacitor C9.

3-37. **AFTERBURNER IGNITION CIRCUIT.** Upon closing of the afterburner pressure switch, ac current flow from the power source passes through ground, the primary winding of transformer T1, through the filter coil L1 and back to the power source. The varying magnetic field built up around the primary winding of T1 by the ac flow, induces a voltage of higher potential in the secondary winding due to an increased turns ratio.

3-38. When the lower end of the secondary winding is negative, current flow is to capacitor C5, electron tube assemblies V2 and V1, and back to the top of secondary winding. When the upper end of transformer secondary winding is negative, current flow is through electron tube assemblies V3 and V4, through resistor R1 to ground, through ground to capacitor C6 and back to the lower end of transformer secondary winding. Each time the electron tube assemblies conduct, capacitors C5 and C6 charge to a higher potential. The series combination of capacitors C5 and C6 is connected in parallel with C7 resulting in capacitor C7 being charged to the same voltage potential as that of capacitors C5 and C6 combined. When the charge on capacitor C7 reaches the breakdown voltage of gap G1, spark gap G1 ionizes. This ionization completes a path allowing capacitor C7 to completely discharge through ground, the spark plug, spark gap G1 and back to the positive side of capacitor C7. Resistor R1 is a current limiting resistor used to protect the electron tube assemblies from any high surge currents during the discharge of capacitor C7.

3-39. The AB circuit filter consists of feed through capacitor C1, coil L1 and capacitor C2 comprising one conventional π type network. The main circuit filter consists of feed through capacitor C3, coil L2 and capacitor C4 comprising a second π type network. The purpose of these filters is to prevent any radio frequency interference generated within the unit from appearing on the input power leads.

3-40. Resistors R2 and R3 protect the ignition circuits in the event of an open discharge circuit.

3-41. See figure 3-1. When the aircraft ignition switch is actuated, current flows from the 28 Vdc source through ground, the normally closed vibrator contacts, the primary winding of transformer T1, the radio filter, and back to the power supply.

3-42. Current flow through the primary winding causes the normally closed vibrator contacts to open. When the vibrator contacts open, current ceases to flow in the primary winding, allowing the vibrator contacts to close. This repeated vibrator action changes the dc current to a pulsating dc current. Capacitor C3, in parallel with the vibrator contacts, prevents arcing across the points when they open.

3-43. As a result of the pulsating dc voltage across the primary of transformer T1, an ac voltage is induced across the secondary of T1. This ac voltage is of an increased potential due to the turns ratio of T1. When the top of T1 is positive, current flows from the secondary winding through ground to capacitor C4, from C4 to V3, V2, V1 and back to the secondary winding. When the top of T1 is negative no current flows because rectifier tubes V1, V2 and V3 do not conduct. Each time the top of T1 is positive, the rectifier tubes conduct, and an additional charge is built up on capacitor C4.

3-44. Spark gap G1 is designed to breakdown (ionize) at 3000 to 3100 Vdc. When the voltage across capacitor C4 reaches this value, gap G1 is ionized and a small current flows from C4 through ground, the shunting surface of the igniter plug, G1 and back to C4. The current flow ionizes the air gap between the electrodes of the igniter plug. With gap G1 and the igniter plug ionized, a large current flows from capacitor C4 through ground, the igniter plug, G1 and back to C4. Resistor R1 in parallel with the igniter plug provides an alternate path for discharging capacitor C4 if the igniter plug becomes open circuited or if the ignition unit is operated with the output open circuited.

3-45. The radio filter consists of feed through capacitor C1, coil L1 and capacitor C2 which comprise a conventional π type network. The purpose of this filter is to prevent any radio frequency interference generated within the unit from appearing on the input power leads.

3-46. The main igniter plug, which fires at relatively low voltages under normal atmospheric conditions, produces high energy sparks for ignition of the fuel air mixture in the combustion section. When the sealed control gap of the ignition unit is ionized, a low impedance path exists through which the tank capacitor can discharge across the igniter plug tip. The igniter plug itself is composed of a center electrode, a ground electrode, and semiconductor material that gaps the two electrodes. Normally, a potential of 1000 to 1500 volts between the electrodes forces enough current through the semiconductor material to ionize the igniter plug gap and discharge the tank capacitor. The operation of the afterburner igniter plug is essentially the same as that of the main igniter plug.

3-47. **AFTERBURNER IGNITION SWITCH.** See figure 3-1. When the main fuel control discharges the afterburner on-off signal to the afterburner fuel pump inlet valve, some of the fuel in the line is diverted to the afterburner ignition switch. This fuel surrounds a bellows within the switch. Reference pressure fuel surrounds a second bellows within the switch. When the afterburner on-off signal pressure increases and exceeds the reference pressure (which could be constant, increasing, or decreasing at the same instant) by 70 $\pm$10 psi, the signal pressure bellows is compressed enough to close the contacts. This completes a path through which current from the aircraft power source (115v, 400 Hz) passes to the ignition unit and to the hydraulic fuel transfer pump control relay. As the differential pressure decreases, the AB ignition switch contacts will remain closed until this pressure differential drops below 40 psi. If a failure occurs in the sensing element, the contacts open.

3-48. The afterburner ignition switch contacts remain closed until the pressure differential drops below 40 psi. If a failure occurs in the sensing element, the contacts open.

3-49. **PRINCIPLES OF OPERATION.**

3-50. The starting system allows the pilot to initiate and control the starting operation for either cartridge or pneumatic starts. Cartridge starts are performed using gas generated from the MXU-4A/A solid propellant cartridge and the aircraft battery as the normal electrical power source. Pneumatic starts are performed using external power as the normal electrical power source and bleed air from a gas turbine air compressor. When both engines are to be started, the right engine should be started first. This is done to determine that both utility hydraulic pumps are operating, and also to avoid entering the right auxiliary air door while the left engine is running. The right pump delivers 2800 psi and the left pump delivers 3000 psi at engine idle RPM. The single needle utility hydraulic system pressure gage can thereby be used to check the output of both the right and left hydraulic pumps.

3-51. See figure 3-1. The main ignition consists of two separate and independent circuits, each is in separate boxes and each requires its own spark plug. The general operation of each circuit is similar.

3-52. When the ignition switch is closed, 28 Vdc flows to both main ignition units. Within the ignition units the dc is converted to ac, increased in amplitude, and rectified to pulsating dc which charges the tank capacitor. The tank capacitor is discharged in periodic surges by a sealed control gap in the ignition unit. The discharge passes through the igniter plug lead, a heavily insulated cable, to the igniter plug. A semiconducting material shunts the igniter plug electrodes. When the voltage between the electrodes reaches approximately 1000 to 1500 volts, enough current flows through the semiconductor to ionize the air gap between the electrodes, permitting the tank capacitor to discharge. The periodic high intensity sparks initiate combustion. Once combustion has been accomplished, burning continues without further sparking; consequently, ignition is turned off.

3-53. When afterburner operation is scheduled, the on-off signal pressure is applied to the afterburner ignition switch, closing the contact points. When the afterburner ignition switch contacts close, current passes from the aircraft 115 Vac power supply to the afterburner ignition circuit of the No. 1 ignition unit and to the hydraulic fuel transfer pump control relay during afterburner operation. The ignition unit increases the applied voltage in amplitude and rectifies it. The direct current charges a tank capacitor within the ignition unit. The tank capacitor collects a relatively large quantity of energy, then periodically releases this through a sealed control gap, discharging across the afterburner igniter plug.

3-54. Normally a potential of 1000 to 1500 volts between the igniter plug electrodes is sufficient to ionize the air gap. The ionized air gap allows electrons to flow across the electrodes, furnishing a low impedance path through which the tank capacitor can discharge. The discharge produces the spark that ignites the fuel air mixture within the torch igniter. The flame from the torch igniter then ignites the fuel air mixture within the tailpipe. The afterburner ignition system functions continuously during afterburner operation.

TOOLS AND TEST EQUIPMENT

3-55. **GENERAL.**

3-56. To perform maintenance on the systems or components, the special tools and test equipment listed in table 3-2 should be used. Alternate equipment with equal or greater range and accuracy than that in the Alternate Equipment column may be substituted. The listed tools and test equipment are for performing aircraft and shop maintenance procedures in this section of the manual.

Table 3-2. Tools and Test Equipment

Name	Identification No.	Alternate Equip. Range	Alternate Equip. Accuracy	Use
Power source, external electrical and pneumatic	M32A-60	200/115v 400 Hz 3Ø 120 lb./min. at 49 psia, U.S. Standard atmosphere at sea level		Engine starting
Pressurizing unit, stator actuator	1C3568G1			To test operation of AB ignition switch
Multimeter	AN/PSM-6( )			

3-57. REMOVAL AND INSTALLATION.

3-58. STARTER. See figure 3-2.

3-59. Materials.

Oil, lubricating, MIL-L-7808
Lockwire, MS20995NC32
Plastilube, Moly Grade 3
Lockwire, MS20995NC20

3-60. Manpower Requirements.

a. Two men required.

3-61. Removal.

a. Disconnect actuator from door 81 L and R.

b. Open door 82R.

c. Open door 82L

d. Remove cartridge breech cap and disconnect cartridge igniter lead.

e. Remove coupling clamp at starter inlet connection and turn duct aft to provide starter removal clearance.

f. Remove coupling clamp at starter exhaust connection and remove exhaust duct.

g. Loosen V band coupling on starter and remove starter.

h. Remove starter adapter mounting bolts and washers.

i. Remove starter adapter.

3-61A. Start Shaft Replacement with Starter Removed.

a. Lift lock tab and remove snap from around shaft.

b. Lubricate with plastic lub Molly No. 3, install shaft and snap ring.

c. Bend tab to hold snap ring in place.

3-61B. Starter Shaft Replacement (Sunstrand) (Starter Removed).

a. Remove drive shaft from starter.

NOTE

Shaft is held in place by a lock ring. If shaft has sheared, it may be necessary to file a flat holding surface 180 degrees apart on broken shaft and pull out shaft with vice grips.

b. Install new shaft.

CAUTION

Insure lock ring is in place and holds shaft securely in starter.

3-62. Installation.

a. Set starter adapter down with projecting dog's facing upward. Place V band coupling over adapter with the split in the outer band as shown. Tighten V band nut over adapter just enough to hold the two pieces together.

b. Install gasket and position adapter on engine pad studs so that the arrow on the adapter points to 12 o'clock position.

c. Install nuts and washers on studs. Torque 190—230 inch—pounds.

d. Apply 2.5 cc Plastilube Moly Grade 3 to exposed end of starter spline.

e. Elevate starter and rotate so that breech chamber is at approximately 8 o'clock. Place it against installed adapter, carefully engaging starter spline with engine spline, and working mounting face flange under locking edge of V band coupling to insure adapter lugs are engaged in starter.

f. *Secure V—band coupling with self locking nut and safety nut. On Sundstrand starter, torque coupling 65 inch—pounds. On Airesearch starter, torque coupling 130 inch—pounds. Torque safety nuts same value as coupling.*

NOTE

Replace safety nut each time V—band coupling is unlatched. Position T—bolt on V—band coupling in any position that doesn't interfere.

g. Install gasket on starter exhaust duct. Secure V—band coupling with self—locking nut and safety nut. *Torque coupling nuts 25 to 30 inch—pounds.*

h. Install gasket on starter inlet duct at starter. Secure V—band coupling with self—locking nut and safety nut. *Torque coupling nuts 75 to 80 inch—pounds.*

i. Connect starter cartridge squib igniter lead. *Secure with lockwire.*

j. Install cartridge breech cap.

3-63. Servicing.

a. Remove magnetic drain plug and filler plug, discard packings.

b. Inspect magnetic plug for presence of loose metal. Small amounts of fine granular material or fuzz is normal, but larger pieces indicate possible internal failure. In such case, remove unit case, remove unit and tag for overhaul.

c. Install new preformed packing on magnetic drain plug and install plug. *Torque Sundstrand starter drain and filler plug to 40—50 inch-pounds; torque Airesearch starter drain and filler plug to 90—110 inch—pounds.*

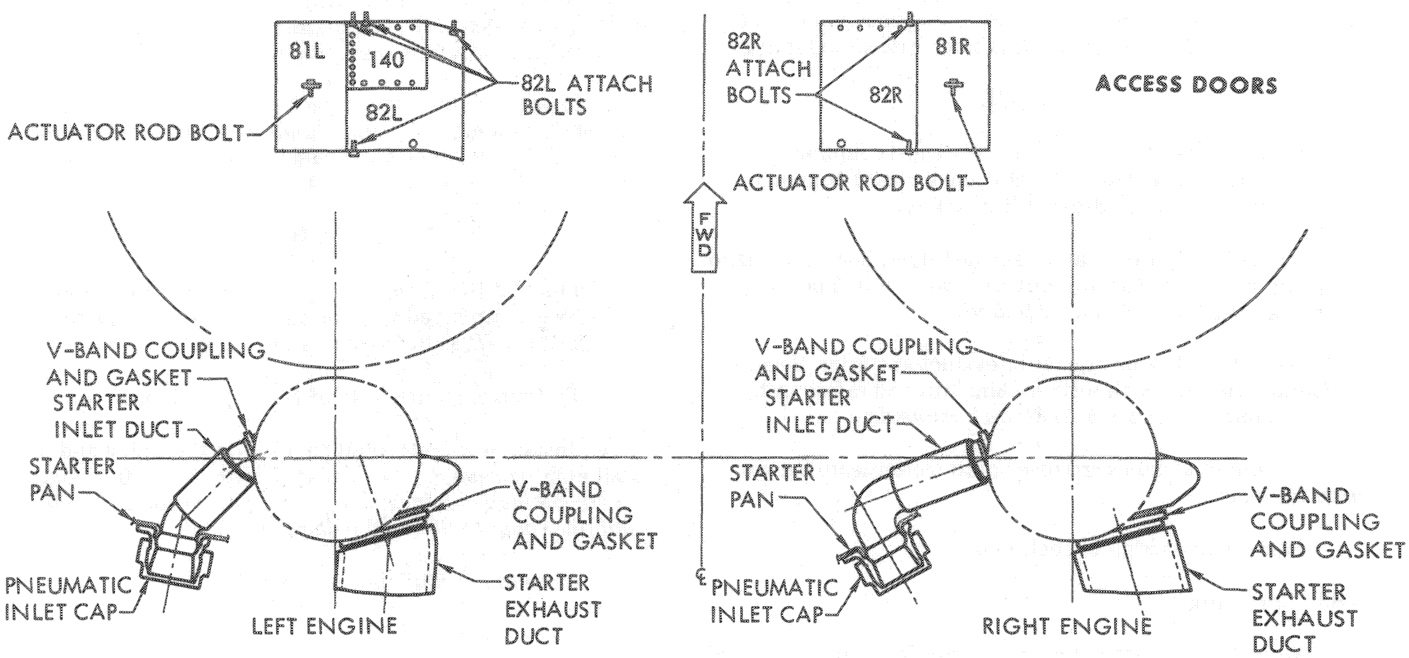
CAUTION

Drain and fill oil sump only after installation. Overfilling sump by adding too much oil before mounting starter is as harmful as a dry sump.

d. Fill starter sump to lip of fill boss with oil.

e. Install new preformed packing on filler plug and install plug. *Torque Sundstrand starter drain and filler plug to 40—50 inch—pounds; torque Airesearch starter drain and filler plug to 90—110 inch—pounds.*

f. *Close doors 82R and 81 L and R.*



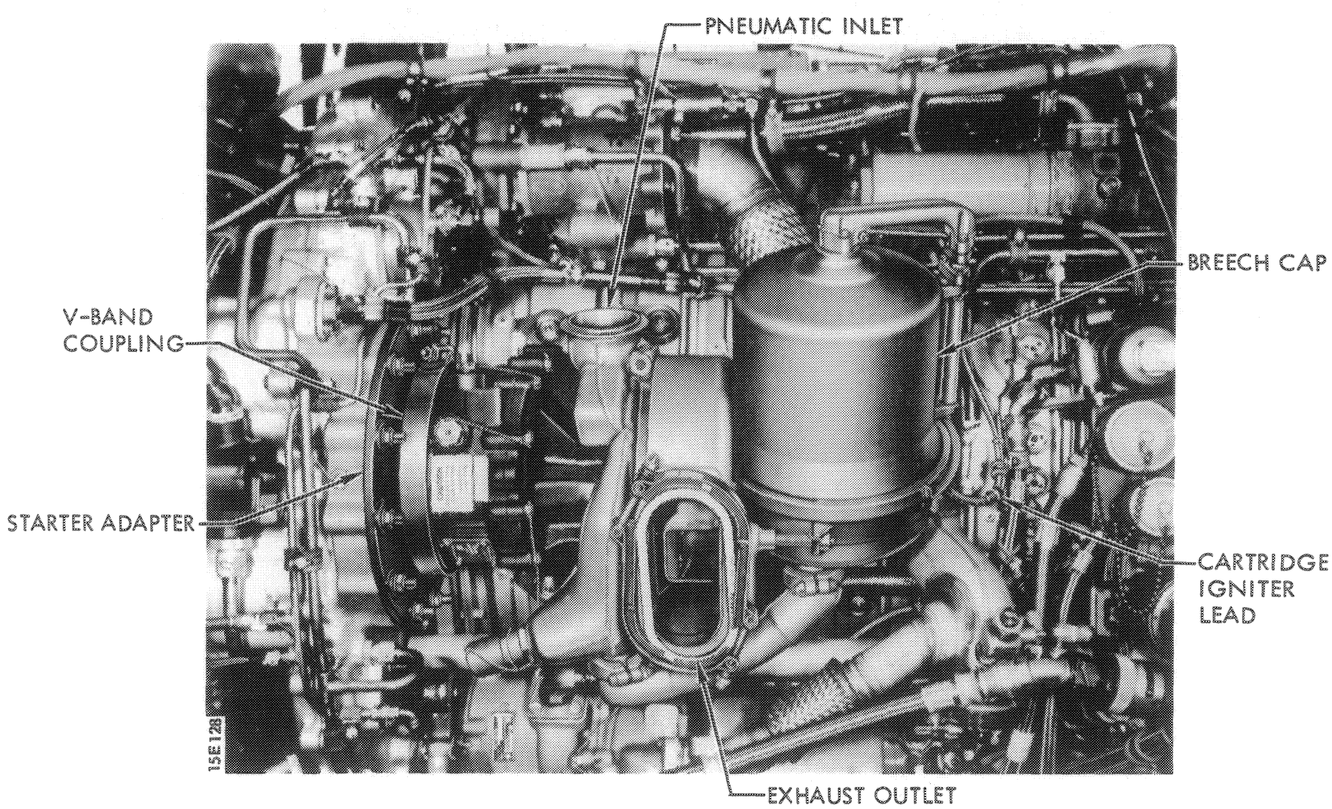


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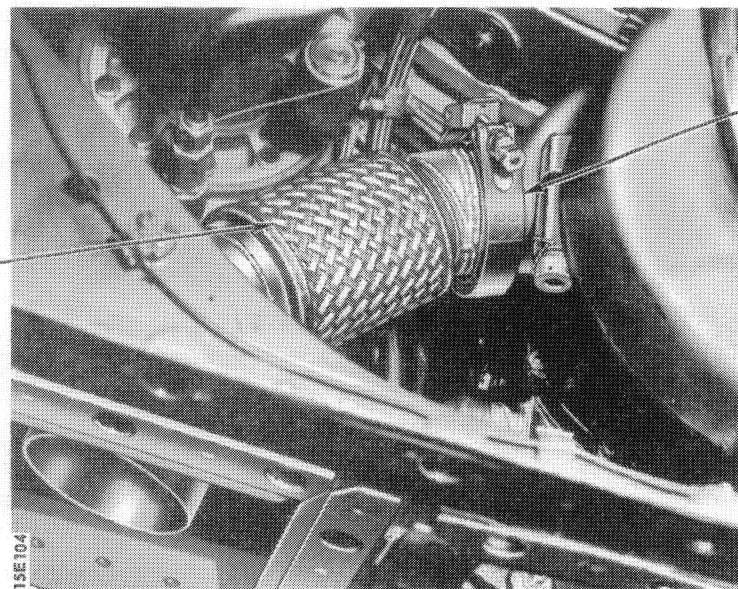
Figure 3-2. Starter Removal and Installation (Sheet 1 of 2)



REMOVE THE COUPLING CLAMP AT THE STARTER INLET CONNECTION AND TURN DUCT AFT (CW) TO PROVIDE STARTER REMOVAL CLEARANCE.

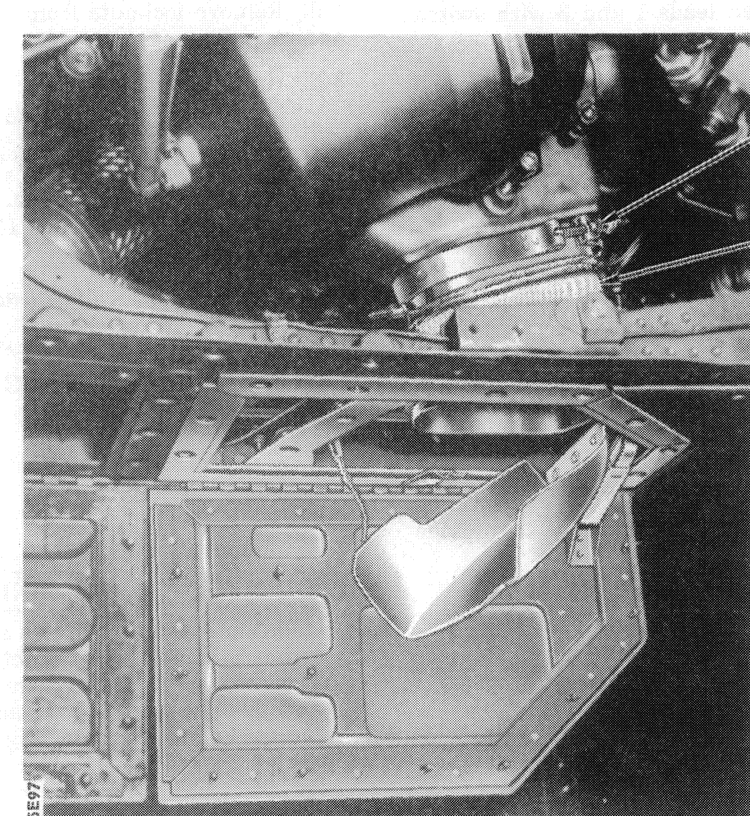


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Figure 3-2. Starter Removal and Installation (Sheet 2 of 2)

3-64. INLET AND EXHAUST DOOR LIMIT SWITCHES.

3-65. Tools and Equipment.

Multimeter

3-66. Materials.

Lockwire, MS20995NC32

3-67. Removal.

a. Open door 82 L and R.

b. Assure cartridges are removed from both starters.

c. Open pneumatic inlet or starter exhaust doors associated with switch being replaced.

d. Disconnect wires and remove switch from mounting bracket.

3-68. Installation.

a. Close door that actuates switch being installed.

b. If switch plunger can be reached with a feeler gage, with switch installed and applicable door closed, install switch and add washers until switch plunger touches door but does not actuate switch.

c. Use feeler gage and multimeter to determine adjustments required to actuate switch. Multimeter indicates continuity between leads 1 and 3 with switch actuated.

d. Remove washers equal to feeler gage dimension ±0.008.

e. Remove two additional thick washers to provide necessary over travel.

f. Install switch to mounting bracket.

g. If switch plunger cannot be reached with feeler gage, with switch installed and applicable door closed, install switch and add washers until switch plunger touches door but does not actuate switch.

h. Connect multimeter to leads 1 and 3.

i. Remove one thin washer at a time until switch actuates. Multimeter indicates continuity between leads 1 and 3.

j. Remove two additional thick washers to provide necessary over travel.

k. Install switch to mounting bracket.

l. *Secure switch with lockwire.*

m. Connect switch wiring. Refer to T.O.1F-4C-2-23.

n. Check switch operation, close pneumatic inlet door and open starter exhaust door.

o. Disconnect bundle plug 52P621 on left engine or 52P623 on right from engine electrical disconnect bracket.

p. Connect multimeter to pin L on bundle plug and to ground.

q. Assure throttles are OFF and then move applicable ENGINE MASTER switch ON.

r. Actuate start select switch to applicable position. 28 Vdc will be indicated on multimeter.

s. Close starter exhaust door and again actuate start select switch. Zero voltage will be indicated on multimeter.

t. Move start select and ENGINE MASTER switches OFF.

u. *Close door 82 L and R.*

3-69. MAIN IGNITION UNITS. See figure 3-3.

3-70. Materials.

Lockwire, MS20995NC32
Lockwire, MS20995NC20

3-71. Removal.

WARNING

Ignition systems operate at voltage and current that is dangerous. Do not work on system while engine is in operation. When working on system, remove input leads from ignition units before disconnecting any other component.

a. Open doors 81 and 83L or 82 and 83R.

b. Cut lockwire and remove power input leads to no. 1 and 2 ignition units.

c. Cut lockwire and remove no. 1 main, no. 2 main and afterburner ignition leads.

d. Remove locknuts from main ignition exciter units and remove ignition units.

3-72. Installation.

a. Position main ignition exciter units and install locknuts. *Torque all locknuts 55 to 70 inch-pounds.*

b. Install no. 1 main, no. 2 main and afterburner ignition leads. *Torque leads 130 to 150 inch-pounds and lockwire.*

c. *Connect power input leads and lockwire.*

d. *Close doors 81 and 83L or 82 and 83R.*

3-73. MAIN IGNITER PLUG. See figure 3-4.

3-74. Materials.

Lockwire, MS20995NC32
Lockwire, MS20995NC20

3-75. Removal.

WARNING

Ignition system operates at voltage and current that is dangerous. Do not service system while engine is running. When servicing with engine stopped, remove input lead from ignition exciter units before disconnecting any other component.

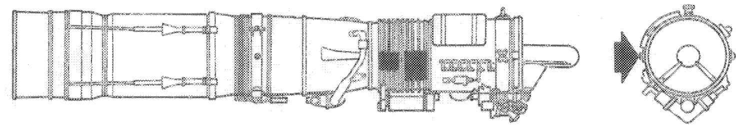
a. Open doors 83 L and R.

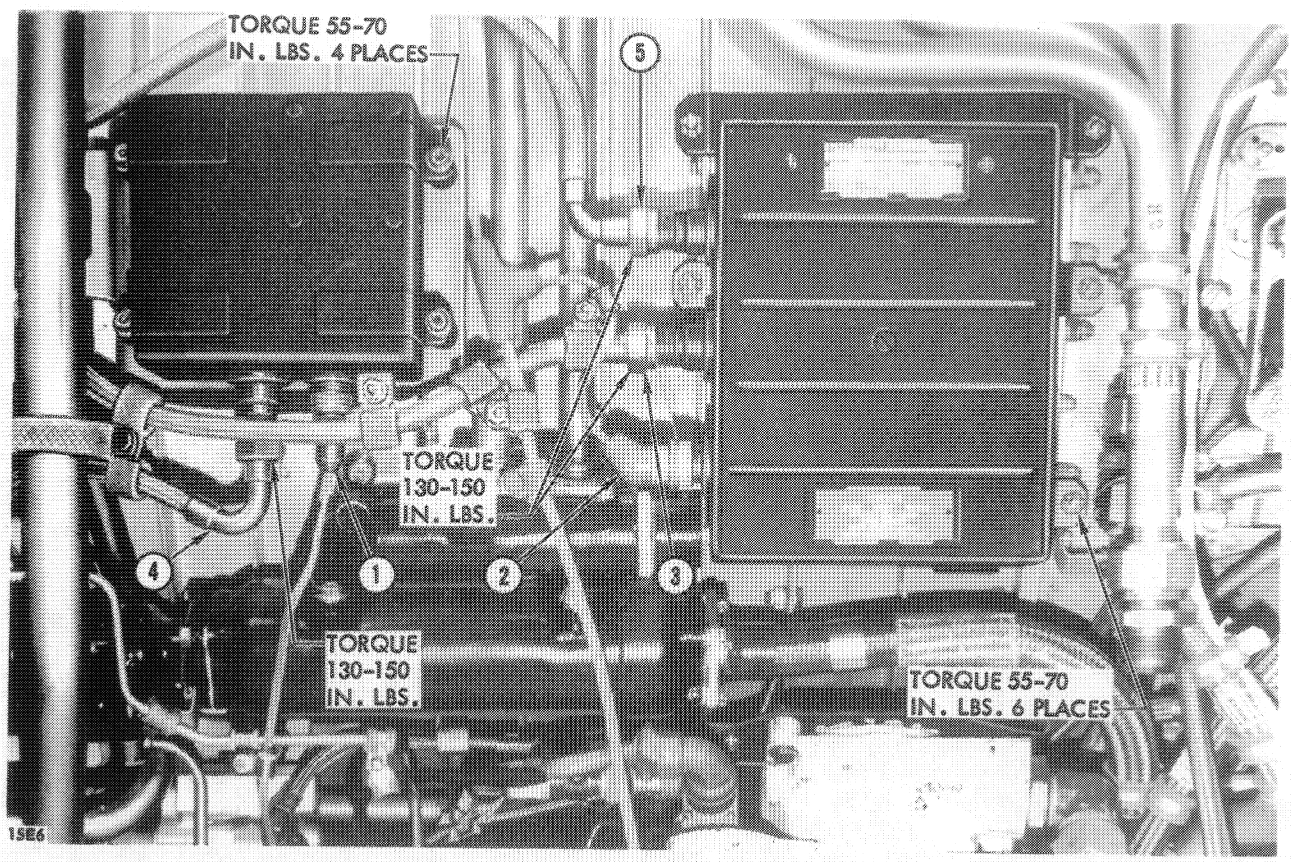
b. Disconnect power input lead from ignition units.

c. Unclamp no. 4 liner flexible lead from afterburner flexible lead and torch igniter orifice bracket.

d. Unclamp no. 5 liner flexible lead from torch igniter fuel line and main fuel manifold.

e. Unscrew lead sleeve nut from combustion outer casing boss and pull lead straight out of casing.

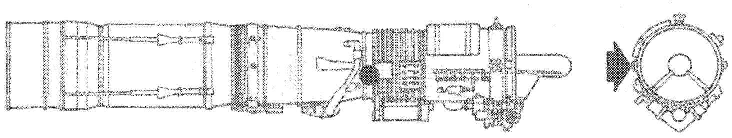


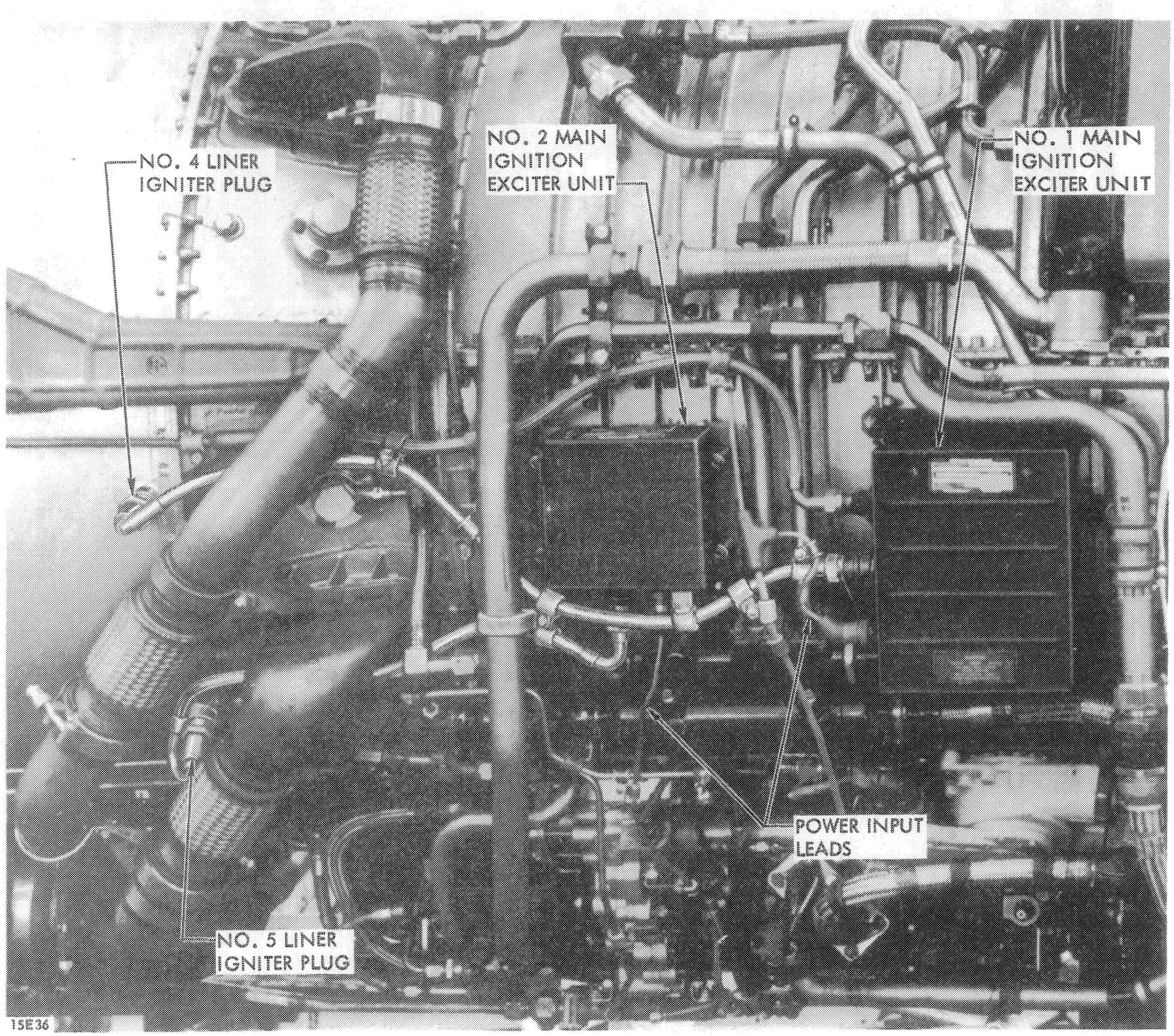


1	POWER INPUT LEAD (NO. 2 IGNITION UNIT)
2	POWER INPUT LEAD (NO. 1 IGNITION UNIT)
3	NO. 1 MAIN IGNITION LEAD (TO NO. 4 LINER IGNITER PLUG)
4	NO. 2 MAIN IGNITION LEAD (TO NO. 5 LINER IGNITER PLUG)
5	AFTERBURNER IGNITION LEAD (TO AFTERBURNER IGNITER PLUG)

4C-2-8-113

Figure 3-3. Main Ignition Unit Removal and Installation





4C-2-8-(124)

Figure 3-4. Main Igniter Plug Removal and Installation

CAUTION

Do not attempt to clean firing end of igniter plug. Doing so might damage semiconductor material.

f. Remove igniter plug and gasket from combustion outer casing.

3-76. **Installation.**

a. Insert igniter plug into combustion outer casing. Install a gasket on igniter plug and install lead. *Torque nut 70 to 80 foot-pounds, back off one quarter turn, retorque 70 to 80 foot-pounds and lockwire.*

NOTE

A small pin on perimeter of igniter plug assembly must be inserted in small hole in combustion outer casing boss.

b. Clamp no. 4 liner flexible lead to afterburner flexible lead and to torch igniter orifice bracket.

c. Clamp no. 5 liner flexible lead to torch igniter fuel line and to main fuel manifold.

d. Connect power input lead to ignition unit. *Tighten finger tight and lockwire.*

e. *Close doors 83 L and R.*

3-77. **AFTERBURNER IGNITER PLUG.** See figure 3-5.

3-78 **Materials.**

Lockwire, MS20995NC32
Lockwire, MS20995NC20

3-79. **Removal.**

a. Open access doors 83 L or R, 92 L or R and 96 L or R.

b. Remove lockwire from sleeve nut and power input lead.

c. Disconnect power input lead from main ignition unit.

d. Unclamp nexible afterburner igniter plug lead from flexible main igniter plug lead and torch igniter orifice pad.

e. Unclamp rigid afterburner igniter plug lead.

f. Disconnect igniter plug from rigid lead. Pull rigid lead straight out.

CAUTION

Do not attempt to clean firing end of igniter plug with an abrasive material or sharp object. If end of plug is covered with carbon, dampen a cloth with fuel and wipe off carbon, or use soft brush or your fingernail to dislodge it.

g. Unscrew igniter plug sleeve nut and remove igniter plug from torch igniter.

3-80. **Installation.**

a. Turn variable seat of igniter plug clockwise to end of threads.

b. Insert igniter plug into torch igniter so control flange seat on liner flange. Jiggle igniter plug to be sure it seats on liner flange. Visually inspect from inside tailpipe to ensure proper installation. See figure 3-5.

c. Turn variable seat on igniter plug counterclockwise until it contacts top of torch igniter boss. To prevent igniter plug from lifting out of its seat, do not turn variable seat any farther.

d. *Torque sleeve nut 40 to 50 inch-pounds and lockwire.*

e. Connect igniter plug to afterburner rigid lead. *Torque 40 to 50 inch-pounds.*

f. Clamp rigid afterburner lead.

g. Clamp flexible afterburner igniter plug leads to flexible main igniter plug lead and torch igniter orifice bracket.

h. Connect power input lead to ignition unit. *Tighten finger tight and lockwire.*

i. *Close access doors 83 L or R, 92 L or R and 96 L or R.*

3-81. **AFTERBURNER IGNITION SWITCH.** See figure 3-6.

3-82. **Materials.**

Lockwire, MS20995NC32
Lockwire, MS20995NC20

3-83. **Removal.**

WARNING

To avoid personnel injury assure that jury strut is installed on door 81R.

a. Open engine access door 82L or gain access through door 81R.

b. Remove lockwire and disconnect electrical connector.

c. Remove lockwire and disconnect reference and signal pressure lines from afterburner ignition switch and cap lines.

d. Remove lockwire and remove clamp attaching bolt.

e. Remove afterburner ignition switch.

3-84. **Installation.**

NOTE

Position pin must align with slotted hole in clamp.

a. Install afterburner ignition switch and clamp attaching bolt.

b. *Torque bolt 55 to 70 inch-pounds and lockwire.*

c. Connect reference and signal pressure lines to afterburner ignition switch.

d. *Secure reference pressure line and torque 135 to 150 inch-pounds.*

e. *Secure signal pressure line and torque 135 to 150 inch-pounds. Lockwire to reference pressure line.*

f. *Connect electrical connector and lockwire.*

g. *Perform afterburner run and check for leakage.*

h. *Close engine access doors.*

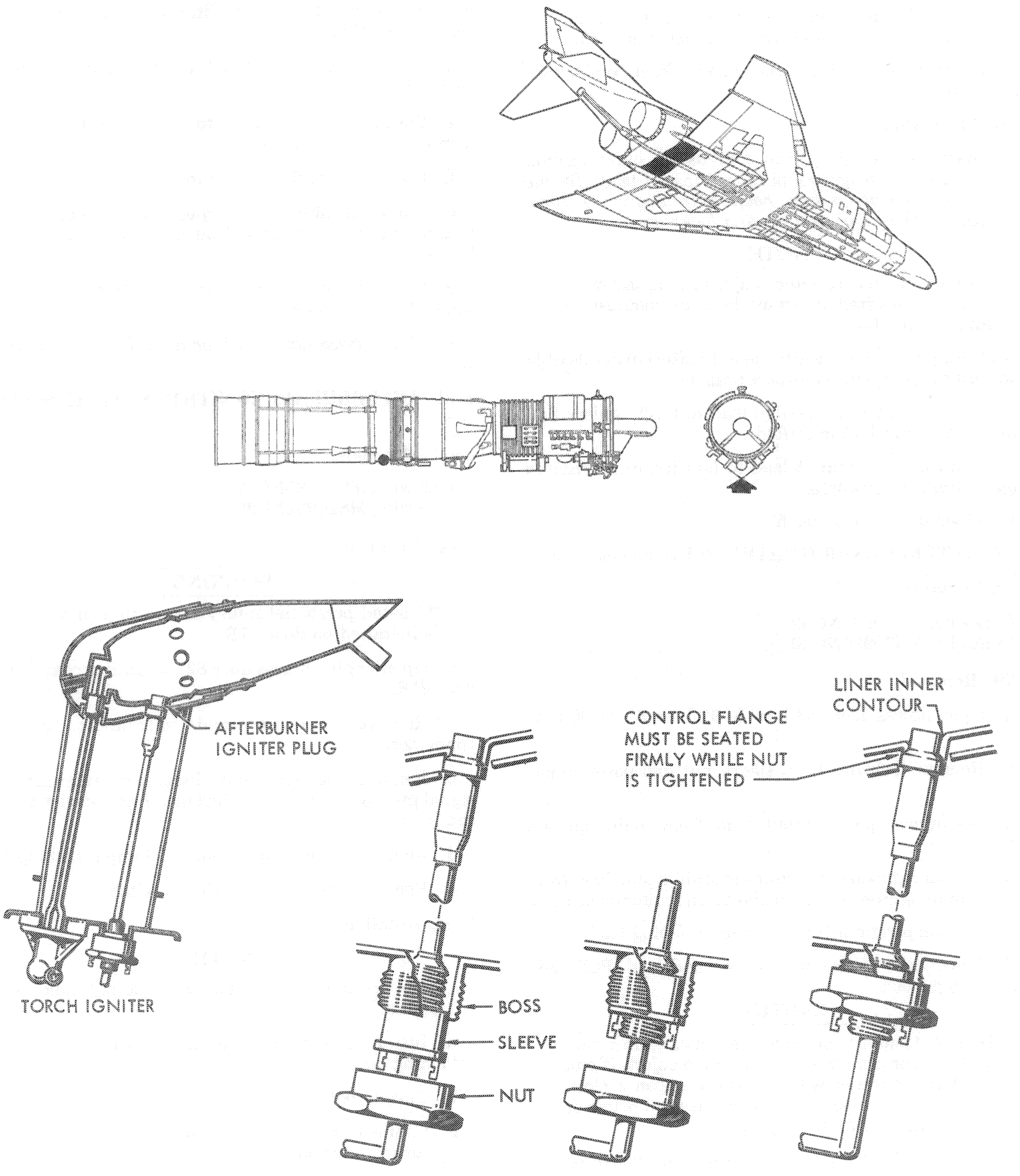
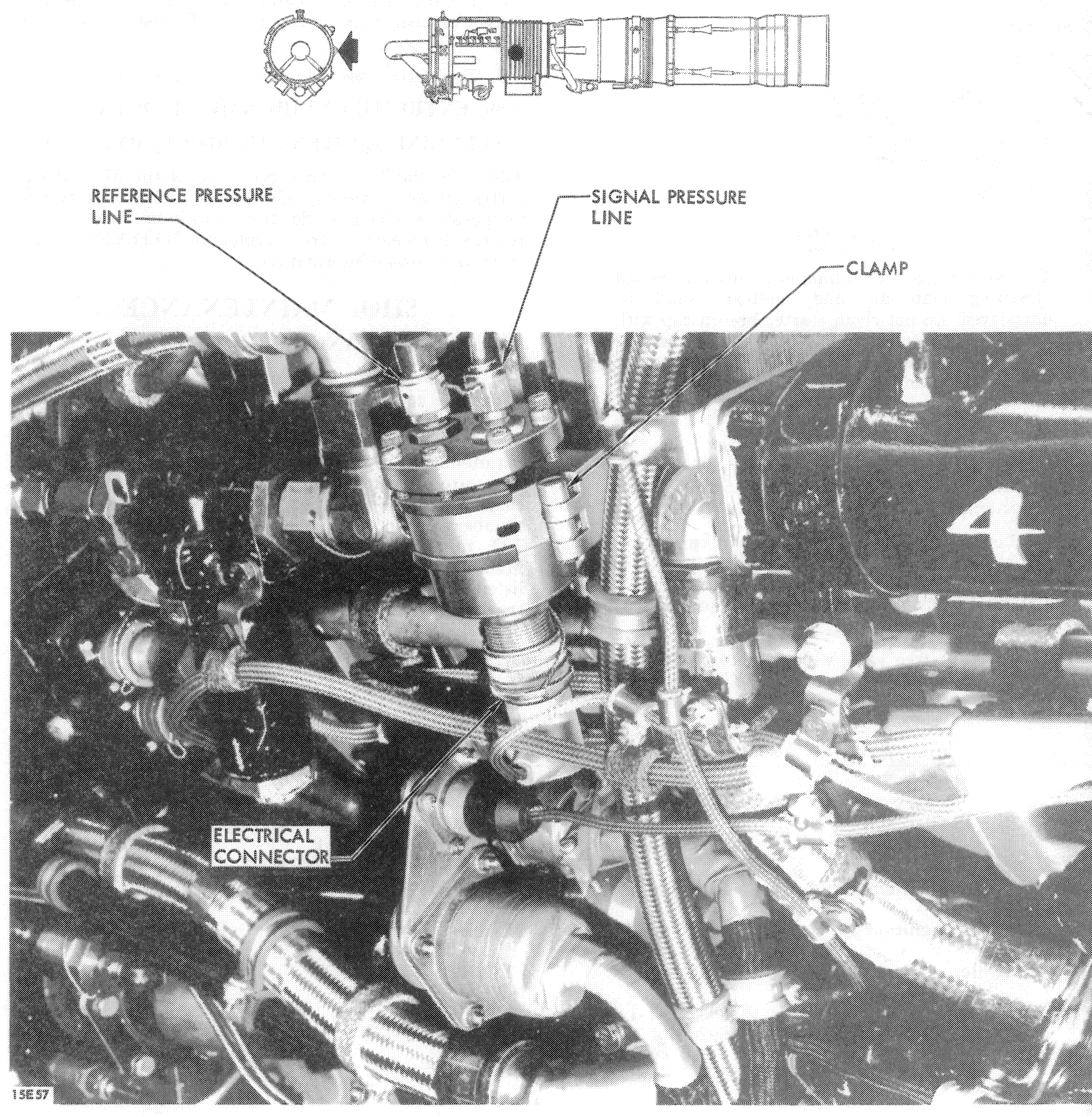


Figure 3-5. Afterburner Igniter Plug Removal and Installation



4C-2-8-(115)

Figure 3-6. Afterburner Ignition Switch Removal and Installation

3-85. CLEANING, DRAINING AND LUBRICATION.

3-86. BREECH CAP.

3-87. Materials.

Soda, bicarbonate, technical
Scouring pad (non—metallic)
Cloth, water dampened
Brush, soft bristle wire

3-88. Cleaning.

CAUTION

To avoid damage to equipment, only authorized cleaning materials and methods shall be employed. Do not clean starter breech cap with jet fuel or other flammable material. Immersing any parts of breech cap assembly having internal insulation in any fluid causes them to fail at first start cycle.

NOTE

Soda and water solution is very effective in cleaning black power residue from breech mechanism.

a. After breech cap has cooled, clean carbon residue from inside surface of breech cap and locking lugs. Wipe residue from surfaces with water and soda solution. If this is not sufficient, steel wool may be used followed by wiping with water dampened cloth.

b. Using lint free rags, wipe surface of dome inside breech cap assembly clean to assure a good electrical contact.

c. If parts of rubber sealing band have remained and cannot be easily wiped away, use a soft bristle wire brush. Wipe clean with water dampened cloth.

d. Dry entire assembly with clean lint free rags.

3-89. EXTREME ENVIRONMENT DATA.

3-90 ENGINE STARTER CARTRIDGE, MXU-4A/A.

3-91. The shelf life and service life of the MXU-4A/A cartridges are adversely affected by high humidity and temperature changes. So that maximum life can be realized from each cartridge, refer to T.O.11A2-3-3-7 for cartridge storage information.

SHOP MAINTENANCE

3-92. MAINTENANCE PROCEDURES.

3-93. This section provides maintenance procedures applicable to components/systems when removed from the aircraft. Table 3-3 lists the functional line replaceable units (LRU) of the system with the location of applicable maintenance procedures. Nonrepairable (consumable) items are not listed. Shop maintenance procedures, when contained in this manual, are referenced by paragraph numbers; when contained in accessory publication, the T.O. numbers of the applicable manuals are listed. Manuals in the F-4 series or in general aircraft series are listed when containing procedures directly applicable to the LRU. When separate overhaul/illustrated parts breakdown manuals have been provided, the T.O. numbers are listed.

Table 3-3. Line Replaceable Units

Line Replaceable Unit	Manufacturers Part Number	Applicable Maintenance Procedures/Publications Shop (Intermediate Level)	Applicable Maintenance Procedures/Publications Overhaul/IPB
Exciter, main ignition 1	106C5281P	T.O.2J-J79-46	
Exciter, main ignition 2	106C5339P	T.O.2J-J79-46	
Plug, igniter		T.O.33D4-6-205-1	
Starter assembly	383242-1-1 692057	2J-A3-38-3 2J-A3-30-3	

3-94. PACKAGING.

3-95. Components to be forwarded to the next higher level of maintenance for repairs, test, or check must be cleaned, preserved and packaged for protection against physical and mechanical damage during subsequent handling, shipping and storage. For preservation and packaging methods referred to herein, refer to AFP 71-4 volumes 1 and 2. Components packed for forwarding must further be identified, marked and documented in accordance with applicable Air Force procedures.

SECTION IV

ENGINE CONTROL SYSTEMS

DESCRIPTION AND OPERATION

4-1. DESCRIPTION.

4-2. The engine control system is comprised of the airframe and engine mounted control linkages. See figures 4-1 thru 4-3. Throttle levers for each engine are on the left console in both the forward and aft cockpits. Mechanical linkage, teleflex cables, and a torque booster transmit mechanical motion from the throttle levers to the main fuel control and other engine accessories requiring mechanical coordination to obtain the desired amount of thrust.

4-3. The control linkage transmits various input and feedback signals to the engine control components. The system is composed of five independent linkage connections:

a. The airframe power plant control system.

b. The engine throttle input linkage transmits a signal representing throttle position to the main fuel control, afterburner fuel control, and nozzle area control.

c. The variable vane feedback linkage transmits a signal representing variable vane position to the main fuel control.

d. The nozzle area control to nozzle pump linkage transmits a signal representing the direction and amount of nozzle movement necessary to establish the scheduled exhaust nozzle area.

e. The nozzle feedback linkage transmits a signal representing exhaust nozzle flap position to the nozzle area control.

4-4. LEADING PARTICULARS. See table 4-1.

Table 4-1. Leading Particulars

FORWARD COCKPIT THROTTLE LEVER TRAVEL	
OFF to IDLE	approximately 9°
OFF to MIL	approximately 34°
OFF to MAX AB	approximately 50°
LOAD LIMITER	
Aft cockpit throttle levers (left or right)	55 to 100 lbs.
SHIFT BREAKOUT FORCE	
Forward cockpit throttle levers (left or right)	8 to 12 lbs.
MAIN FUEL CONTROL	
Power shaft rotational angle	
0 to 4.5°	Engine OFF
4.5 to 10°	Transition from OFF to IDLE
10 to 13°	IDLE (65 ±1.0%)
13 to 65°	Transition from IDLE to top speed (100 ±0.5%)
65 to 71°	Transition from top speed to military (MIL) power
71 to 75°	Military power
75 to 78°	Transition from military to minimum afterburner (MIN AB)
78 to 110°	Minimum afterburner to maximum afterburner (MAX AB) operation
110 to 113°	Maximum afterburner
Operating fluids	MIL-T-5624, grade JP-4
Supply pressure ratings	135 psi - minimum for operation; 950 psi - maximum for operation; 1050 psi - maximum for any condition
Flow ratings	250 pph - maximum required to rotate booster 100° per second against a 60 inch-pound output load
Normal operating torque ratings	0 to 5 inch-pounds input; 0 to 60 inch-pounds output, transient; 0 to 80 inch-pounds output, breakaway
Maximum allowable torque under any condition	300 inch-pounds
Output shaft rotation	10 to 123° - maximum

4-5. COMPONENT DESCRIPTION. The control system components consist of a forward and aft cockpit throttle quadrant, aft cockpit dual control box, airframe mounted engine control box, torque booster, flexible cables and engine mounted control boxes on the main fuel control, nozzle area control and afterburner fuel control.

4-6. On aircraft BEFORE T.O.1F-4-860, throttle stops in the forward cockpit throttle quadrant prevent inadvertent engine shutdown when retarding the forward cockpit throttle levers to IDLE position. The finger lift idle stop is installed on aircraft AFTER T.O.1F-4-860 to prevent inadvertent engine shutdown when retarding the forward cockpit throttle levers to IDLE position. See figure 4-2.

4-7. A friction lever is mounted between the forward cockpit throttle levers which permits adjustment of throttle lever friction to suit individual requirements. The friction lever is used also when performing maintenance on the throttle system.

4-8. The switches located on the forward cockpit throttle quadrant and throttle levers are as follows:

a. Main engine ignition switches on the aft side of each throttle lever for the respective engine.

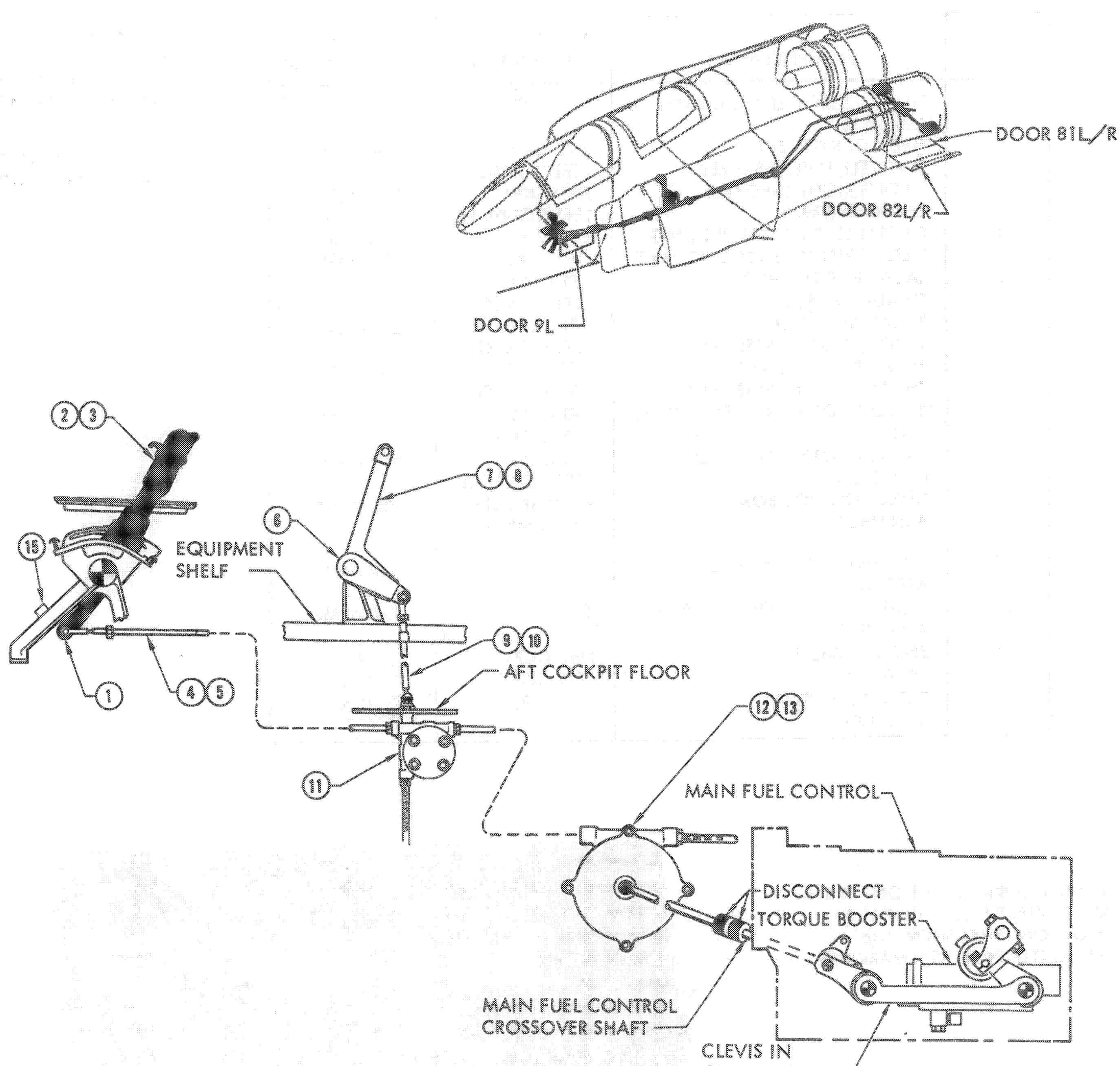
b. Speed brakes switch on the inboard side of right throttle lever.

c. Microphone switch is on the inboard side of right throttle lever below the speed brake switch.

d. The auto acquisition switch is on the outboard side of the left throttle lever.

e. Throttle cutoff switches are below the console panels across the forward side of the throttle quadrant. The throttle cutoff switches control the engine fuel shutoff valve operation in conjunction with the engine master switches on the engine master panel.

f. The aft cockpit throttle quadrant left throttle lever also contains a speed brake switch and microphone switch on the inboard side.



NOTE

1 MASTER SWITCH IDENTIFICATION GUARD INSTALLED AFTER T.O. 1F-4-946.

4C-2-8-(133-1)

Figure 4-1. Airframe Power Plant Control System Orientation (Sheet 1 of 2)

INDEX NO.	NOMENCLATURE	ACCESS DOOR OR LOCATION	REFERENCE DESIGNATION
1	PILOT'S THROTTLE QUADRANT ASSEMBLY	9L	
2	FWD COCKPIT LEFT THROTTLE LEVER ASSEMBLY	FWD CKPT LEFT CONSOLE	204AA2M1
3	PILOT'S RIGHT THROTTLE LEVER ASSEMBLY	FWD CKPT LEFT CONSOLE	204AA2M2
4	PILOT'S LEFT TELESCOPIC UNIT	9L	204AA6M5
5	PILOT'S RIGHT TELESCOPIC UNIT	9L	204AA6M6
6	RADAR PILOT'S THROTTLE QUADRANT ASSEMBLY	AFT CKPT LEFT CONSOLE	
7	RADAR PILOT'S LEFT THROTTLE LEVER ASSEMBLY	AFT CKPT LEFT CONSOLE	204AA3M1
8	RADAR PILOT'S RIGHT THROTTLE LEVER ASSEMBLY	AFT CKPT LEFT CONSOLE	204AA3M2
9	RADAR PILOT'S LEFT TELESCOPIC UNIT	AFT CKPT LEFT CONSOLE	204AA3M3
10	RADAR PILOT'S RIGHT TELES-COPIC UNIT	AFT CKPT LEFT CONSOLE	204AA3M4
11	DUAL CONTROL BOX ASSEMBLY	FORWARD LEFT HAND MISSILE CAVITY	204AA3M5
12	LEFT ENGINE CONTROL BOX ASSEMBLY	81L	204AA6M1
13	RIGHT ENGINE CONTROL BOX ASSEMBLY	81R	204AA6M2
14	ENGINE MASTER SWITCHES	FWD CKPT LEFT CONSOLE	7S244(R) 7S245(L)
15	THROTTLE CUTOFF SWITCHES	9L	7S246(R) 7S247(L)

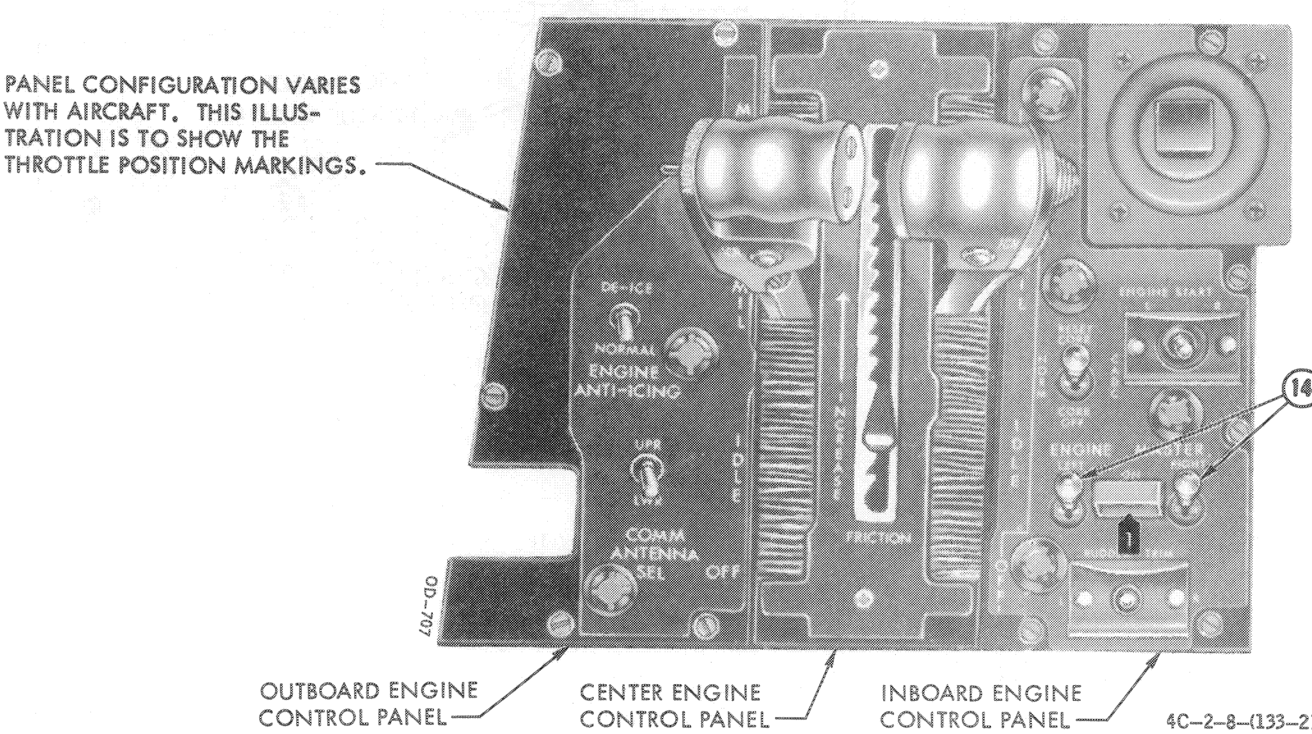
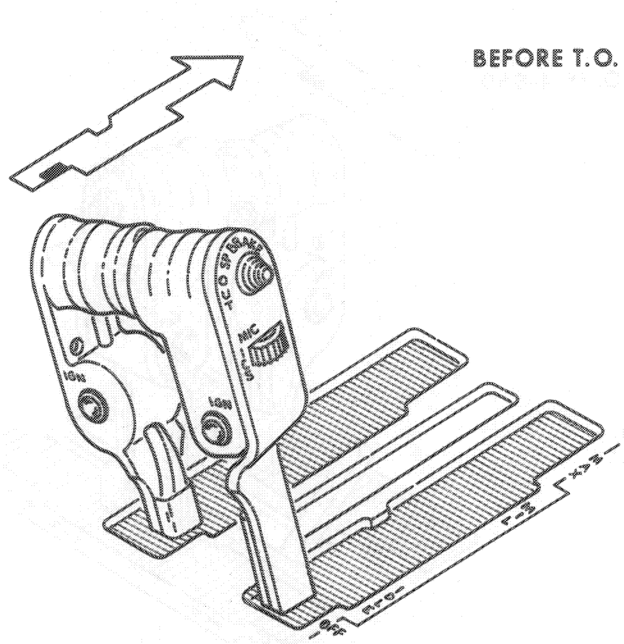


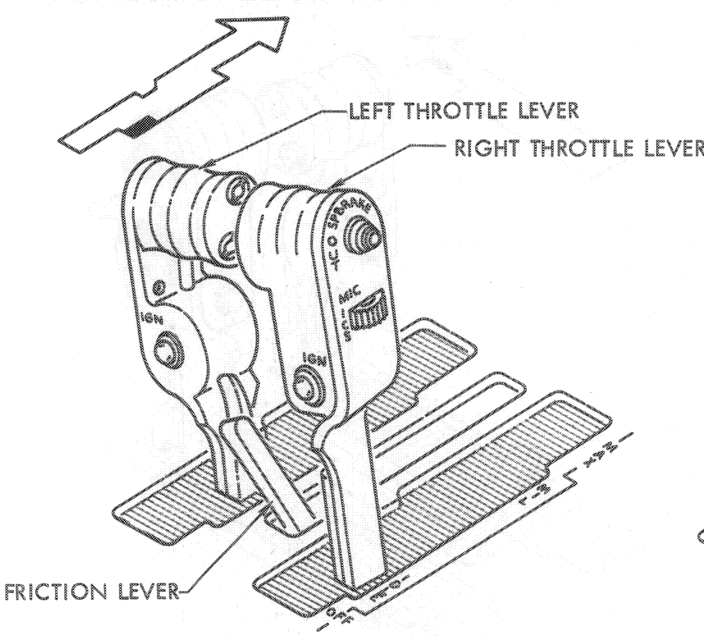
Figure 4-1. Airframe Power Plant Control System Orientation (Sheet 2 of 2)

BEFORE T.O. 1F-4-860



OFF POSITION

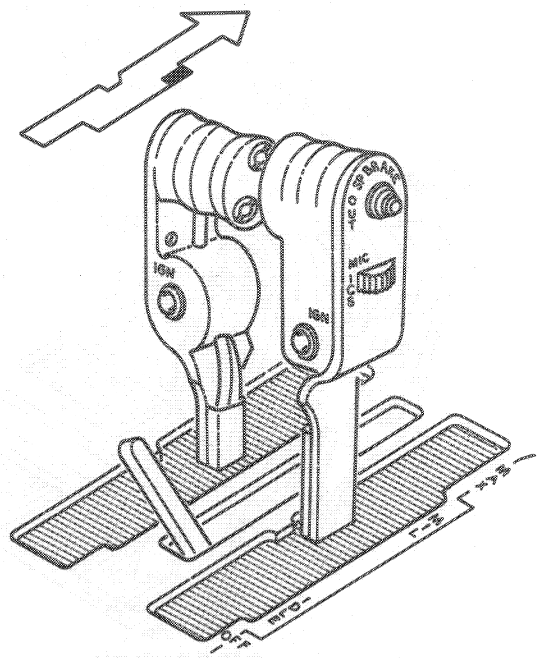
A THROTTLE LEVERS ARE POSITIONED FULL AFT IN THE OFF POSITION, THROTTLE CUTOFF SWITCHES ARE ACTUATED AND ENGINE MANIFOLD SHUTOFF VALVES ARE CLOSED.



IDLE POSITION

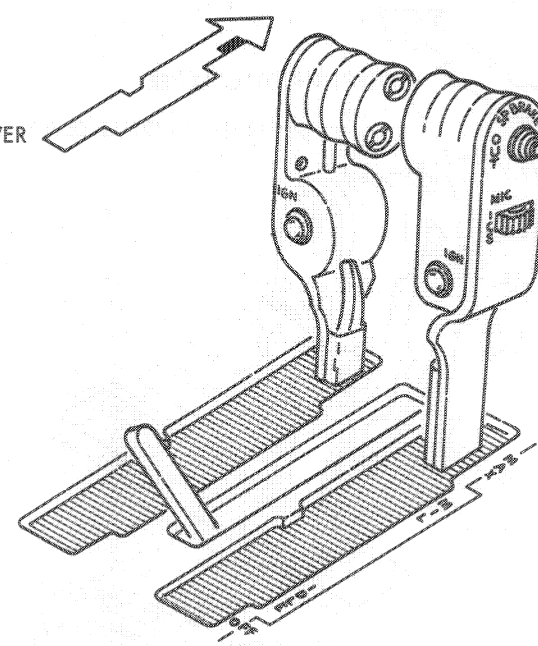
B WHEN ADVANCING THROTTLE LEVER CAM ACTION OF IDLE STOP WILL SHIFT THROTTLE LEVER INBOARD FROM OFF TO IDLE.

THE CUTOFF SWITCHES WILL DEACTUATE ALLOWING ENGINE MANIFOLD SHUTOFF VALVES TO OPEN WHICH PROVIDES FUEL FLOW TO ENGINE.



MILITARY (MIL) POSITION

C FROM IDLE POSITION, THE THROTTLE LEVERS ARE ADVANCED STRAIGHT FORWARD TO REACH MILITARY POSITION. THROTTLE LEVERS MAY BE POSITIONED ANYWHERE IN THE IDLE TO MIL RANGE.



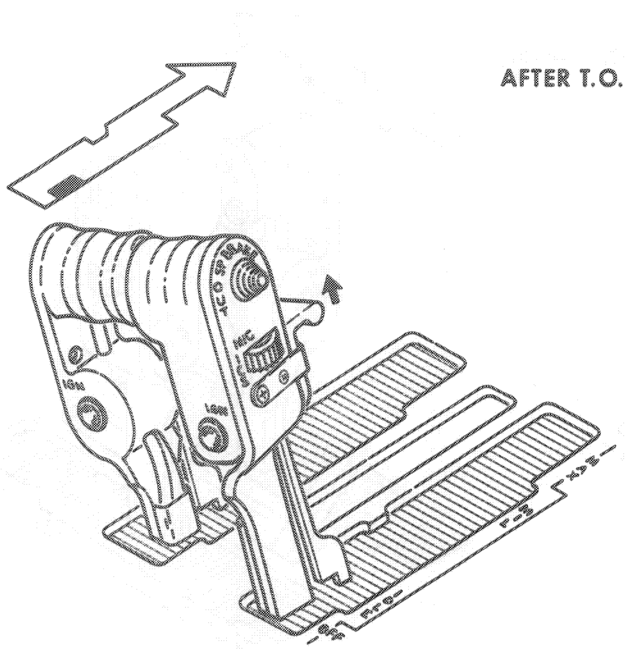
AFTERBURNER (MAX) POSITION

D FROM THE MIL POSITION, AFTERBURNER OPERATION IS INITIATED BY SHIFTING THROTTLE LEVERS OUTBOARD AND THEN ADVANCING SLIGHTLY. AFTERBURNER OPERATION CAN BE VARIED WITHIN AFTERBURNER (MAX) RANGE TO OBTAIN THE DESIRED AMOUNT OF THRUST AUGMENTATION.

4C-2-8-(180-1)

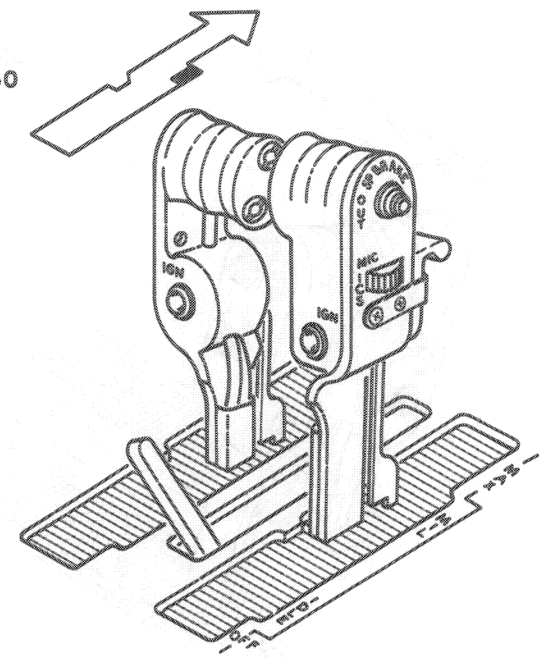
Figure 4-2. Forward Cockpit Throttle Lever Positions (Sheet 1 of 2)

AFTER T.O. 1F-4-860



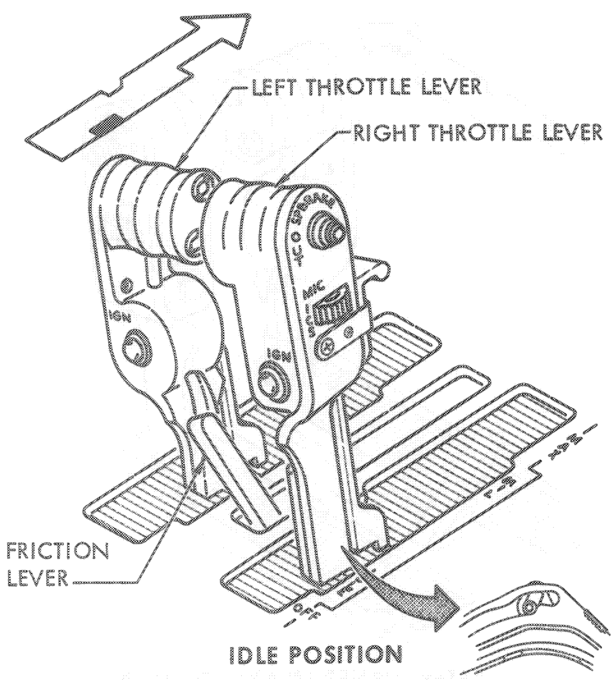
OFF POSITION

A THROTTLE LEVERS ARE POSITIONED FULL AFT IN THE OFF POSITION THROTTLE CUTOFF SWITCHES ARE ACTUATED AND ENGINE MANIFOLD SHUTOFF VALVES ARE CLOSED.



MILITARY (MIL) POSITION

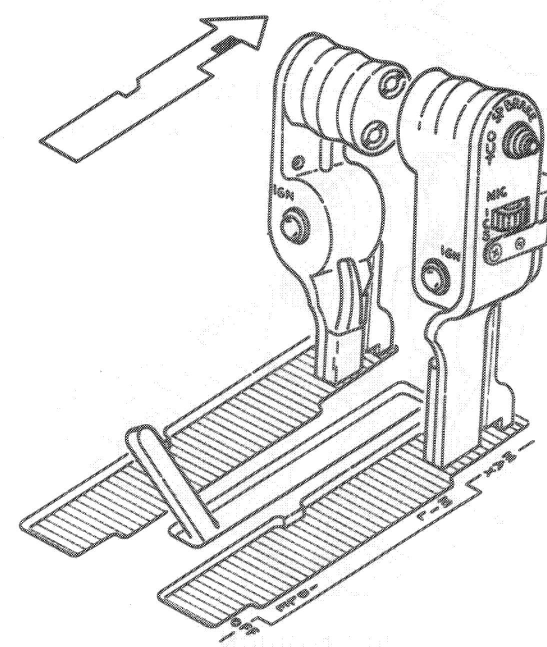
C FROM IDLE POSITION, THE THROTTLE LEVERS ARE ADVANCED STRAIGHT FORWARD TO REACH MILITARY POSITION. THROTTLE LEVERS MAY BE POSITIONED ANYWHERE IN THE IDLE TO MIL RANGE.



IDLE POSITION

B THE THROTTLES CAN BE ADVANCED FROM OFF TO IDLE BY MOVING THE THROTTLES FORWARD. THE FINGER LIFT IDLE STOPS MUST BE RAISED TO GO INTO THE OFF POSITION.

THE CUTOFF SWITCHES WILL DEACTUATE ALLOWING ENGINE MANIFOLD SHUTOFF VALVES TO OPEN WHICH PROVIDES FUEL FLOW TO ENGINE.



AFTERBURNER (MAX) POSITION

D FROM THE MIL POSITION, AFTERBURNER OPERATION IS INITIATED BY SHIFTING THROTTLE LEVERS OUTBOARD AND THEN ADVANCING SLIGHTLY. AFTERBURNER OPERATION CAN BE VARIED WITHIN AFTERBURNER (MAX) RANGE TO OBTAIN THE DESIRED AMOUNT OF THRUST AUGMENTATION.

4C-2-8-(180-2)

Figure 4-2. Forward Cockpit Throttle Lever Positions (Sheet 2 of 2)

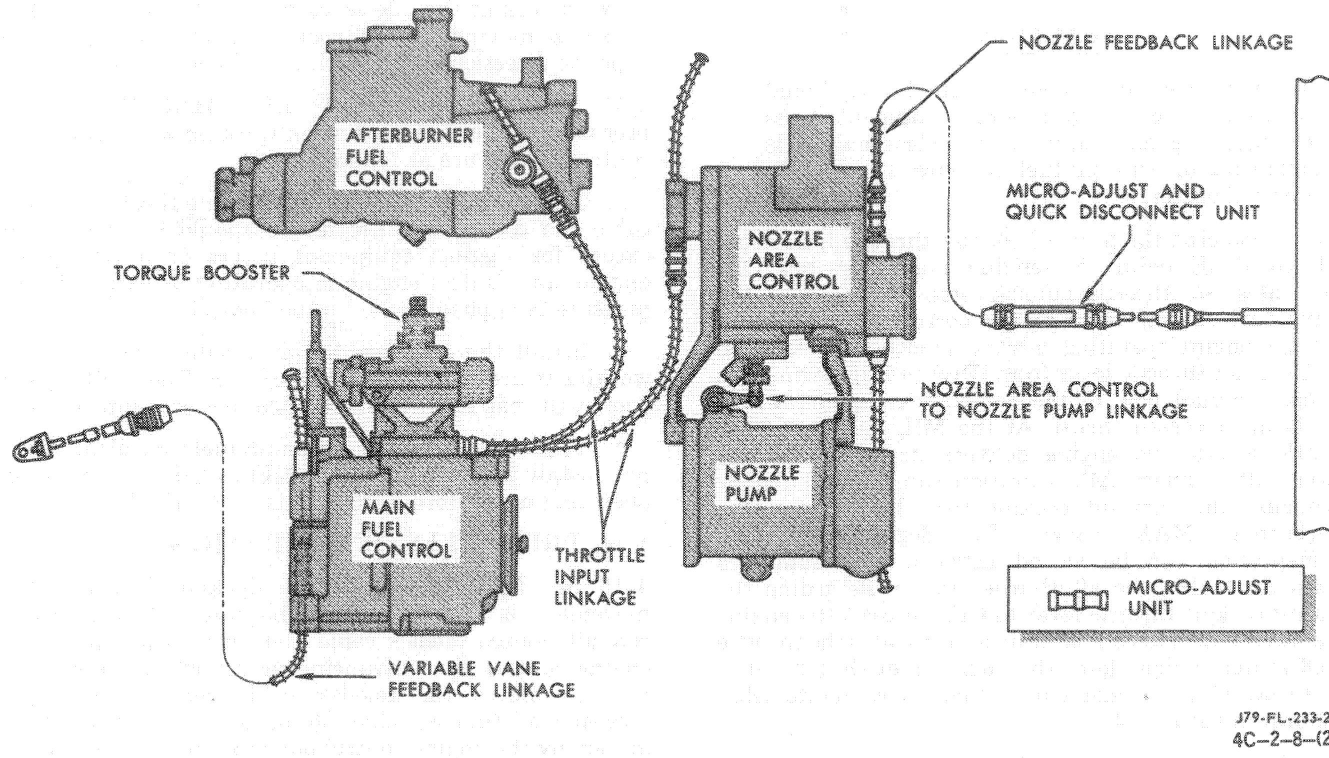


Figure 4-3. Engine Control Linkage System

OPERATION

4-9. SEQUENCE OF OPERATION.

CAUTION

To reduce wear on system, throttle levers should not be moved except for rigging, equipment access or initiating an engine start, unless engine is operating or external fuel pressure is applied to torque booster.

4-10. Advancing the forward cockpit throttle lever from OFF to IDLE (with the engine master switch ON) deactivates the throttle cutoff switch which opens the engine fuel shutoff valve to the corresponding engine. With the engine operating, advancing either the forward or aft cockpit throttle lever from IDLE to MIL permits an increase in fuel flow to the combustion section which results in increased thrust. At the MIL position of the throttle levers, the engine delivers its rated military power. Afterburner (AB) operation can be initiated by advancing the forward cockpit throttle lever to the afterburner (MAX) range. The degree of thrust augmentation can be varied between minimum and maximum within the afterburner range. Retarding the forward cockpit throttle lever to OFF returns the engine main fuel control to OFF position and actuates the throttle cutoff switch which closes the engine fuel shutoff valve. The throttle lever to engine main fuel control relationship is shown in figure 4-4.

4-11. Detents are built into the forward cockpit throttle quadrant to provide definite ranges of operation and prevent the accidental selection of an undersired throttle lever position. On aircraft BEFORE T.O.1F-4-860, when advancing the forward cockpit throttle lever from OFF to IDLE position the cam action of the tapered idle stop will shift the throttle lever inboard to the IDLE-MIL range of operation. On aircraft AFTER T.O.1F-4-860, the forward cockpit throttle lever does not require shifting at IDLE position when advancing from OFF towards the MIL position. The finger lift idle stop cam provides a positive throttle lever stop when retarding the cockpit throttle levers from MIL to IDLE position and allows a straight and nonrestricted movement forward from OFF to MIL position. The forward cockpit throttle lever must be shifted outboard at the MIL position when advancing to the afterburner range of operation.

4-12. The aft cockpit throttle levers move with the forward cockpit throttle levers throughout the entire range of operation. Throttle operation from the aft cockpit is limited by the detents of the forward cockpit throttle quadrant. Aft cockpit throttle lever operation permits control of the engine power output in the range between IDLE and MIL and throughout the afterburner range, also to retard the throttles from afterburner range to the IDLE to MIL range. The aft cockpit throttle operation permits forward throttle lever movement from OFF to MIL. The aft movement of the throttle lever will be from AB range to IDLE. Assistance from the forward cockpit is required to advance the throttle lever into the AB range or retard the throttle lever into the OFF position. The aft cockpit throttle levers each contain a load limiting device. The load limiter is installed to prevent damage of the teleflex cable in the event a force is applied to both forward and aft cockpit throttle levers simultaneously. The aft cockpit throttles become disengaged from the airframe throttle system when a force of 55 to 100 pounds is applied to the aft cockpit throttle levers in either the forward or aft direction. The load limiter can be reset by placing the forward cockpit throttle lever against the IDLE or MIL stop and moving the aft cockpit throttle lever in the opposite direction from which the disconnect occurred.

4-13. **PRECAUTIONS TO BE OBSERVED.** The precautions to be observed when working with the engine control system are as follows:

a. To prevent damage to the airframe throttle teleflex cable the cockpit throttle levers should not be moved except for rigging; equipment access or initiating an engine start unless engine is operating or external fuel pressure is applied to the torque booster.

b. Install the auxiliary air door safety struts before working in area of the auxiliary air door. The auxiliary air doors will snap shut when electrical power is interrupted.

c. To prevent damage to the main fuel control (MFC) do not install the rig pin in the MFC when the engine is operating or the torque booster is pressurized.

4-14. PRINCIPLES OF OPERATION.

4-15. See figures 4-3 and 4-4. Cockpit throttle lever movement is transmitted to the torque booster by a conduit housed teleflex cable and an airframe mounted engine control box. Advancing or retarding the cockpit throttle moves the teleflex cable fore-and-aft. The fore-and-aft (linear) cable motion is converted to rotary motion by the engine control box mounted on the keel in the engine bay. This rotary motion is then applied to the main fuel control (MFC) crossover shaft through a clevis arm to the torque booster input shaft. The torque booster hydraulically amplified the input force and transmits the movement to the MFC power shaft and throttle input linkage.

4-16. COMPONENTS.

4-17. **Forward Cockpit Throttle Quadrant.** The forward cockpit throttle quadrant contains throttle levers for the control of each engine. Any movement of the throttle levers is transmitted by mechanical linkage to the engine main fuel control (MFC) and results in a change of engine power output. Throttle lever friction can be increased to suit individual requirements or to retain the throttle levers in a stationary position by moving the throttle friction lever forward. On aircraft with throttle quadrants modified by overhaul to incorporate the throttle lever friction adjust, the throttle levers contain an independent lever friction adjustment screw on the forward side of the lower throttle lever (below panels). This adjustment screw, and a plastic plug contacting the throttle quadrant shaft, provides a means of equalizing the friction between the right and left throttle system.

4-18. The switches on the throttle quadrants are defined in paragraph 4-8.

4-19. **Aft Cockpit Throttle Quadrant.** The aft cockpit throttle quadrant contains throttle levers for the control of each engine. Although the aft cockpit throttle levers have full travel, they cannot be advanced into the MAX position without assistance from the forward cockpit. Assistance from the forward cockpit is also required when retarding the levers from IDLE to OFF but not from MAX to IDLE. The aft cockpit throttle lever movement is directly related to forward cockpit throttle lever

movement, as both the forward and aft cockpit teleflex cables are routed through a double sheave wheel in the aft cockpit dual control box.

4-20. The aft cockpit throttle lever assemblies each contain a load limiting device which allows the levers to disengage when an excessive load (55 to 100 pounds) is applied. The load limiting device consists of a plunger operated by a coil spring. The plunger and spring are attached to the lever and engage the lever bellcrank causing the entire assembly to move as a unit during normal operation. Once the lever is disengaged from the bellcrank, the bellcrank continues to move with the rest of the system but the lever is inoperative until the load limiter is reset. Lever reset is obtained by positioning the forward cockpit throttle lever against the IDLE or MIL stop and moving the aft cockpit throttle lever in the opposite direction from which disengagement occurred.

4-21. The aft cockpit right throttle lever houses a speed brake switch and a microphone switch.

4-22. **Airframe Power Plant Control System.** Movement of the forward or aft cockpit throttle levers is transmitted by a teleflex cable through the aft cockpit control box to the airframe keel mounted engine control box. The teleflex cable is housed in an unlined conduit with micro-adjust units in the engine bay. The teleflex cable helix engages a sheave wheel in the engine control box. The engine control box converts linear motion of the teleflex cable to rotary motion necessary to operate the engine mounted torque booster and throttle input linkage.

4-23. **Teleflex Cable, Conduit and Couplings.** The teleflex consists of a core of small wires with a spiral (helix) wrap on the outside. The teleflex cable is enclosed in conduit from the throttle quadrant telescopic units to the control boxes. The conduit ends are connected with couplings to insure a smooth low friction throttle system. On 62-12199 THRU 64-737 an adjustable coupling (micro-adjust unit) is used with the plain unlined conduit and located in the 82L/R doors. The micro-adjust unit functions the same as a turnbuckle to lengthen or shorten the conduit between the dual control box and the engine control box. To vary the conduit length has the same effect as lengthening or shortening the teleflex cable. This permits alignment of the engine control box shaft splines to the MFC crossover shaft splines during system rigging. On 64-738 AND UP the micro-adjust used with the plain unlined conduit is located in the 74L/R door and is not accessible for system rigging with the engine installed.

4-24. **Engine Control Box.** The engine control box mounts to the keel in each engine bay. Each box consists of a wheel with a shaft attached to the center. The teleflex cable engages the outside of the wheel and fore-and-aft motion of the cable, caused by throttle lever movement, is converted into rotary motion of the shaft. The rotary motion of the shaft is applied to the main fuel control crossover shaft and transmitted to the input shaft of the torque booster through mechanical linkage.

4-25. **Aft Cockpit Dual Control Box.** The dual control box contains two double grooved sheaves. The teleflex cables connecting the forward cockpit throttle levers to the engine control boxes pass through the aft cockpit control box and engage one groove on each sheave. A short section of teleflex cable connects to each of the aft cockpit throttle levers and engages the remaining groove of each sheave. Thus the control box provides the connection between the forward and aft cockpit throttle levers.

4-26. **Throttle Input Linkage.** Movement of the cockpit throttle lever rotates the input shaft of the torque booster. The torque booster hydraulically amplifies the input force and transmits the movement to the main fuel control throttle input shaft.

4-27. The cable box, bolted to the main fuel control, has a sheave which is connected to the main fuel control input shaft through a toothed clutch. The input shaft rotates the sheave when the clutch is engaged. As the sheave rotates, a flexible cable which meshes with the sheave is moved. A wire wound spirally around the cable engages grooves in the sheave to keep the cable from slipping. The cable transmits movement, through teflon-lined cable conduits, to sheaves in cable boxes on the afterburner fuel control and nozzle area control.

4-28. **Variable Vane Feedback Linkage.** The variable vane feedback cable attaches to the right, first-stage bellcrank through a swivel assembly. Movement of the vanes is transmitted by the flexible cable, through the teflon-lined cable conduit, to the sheave of the feedback cable box on the main fuel control. The feedback shaft in the control is spring-loaded to keep the cable under tension.

4-29. **Nozzle Area Control to Nozzle Pump Linkage.** When a change in exhaust nozzle area is required, the nozzle area control output rod moves either into or out of the control body. Motion of the output rod is transmitted to the nozzle pump control lever. As the lever moves, it rotates the pump input shaft and the control valve then repositions the thrust plate to direct high-pressure oil to the rod-end or head-end of the nozzle actuators.

4-30. **Nozzle Feedback Linkage.** The nozzle feedback cable has two sections, a forward cable and an aft cable. The aft cable is connected to the nozzle support ring through a telescopic unit. The forward cable engages the sheave of nozzle area control feedback cable box. The forward and aft cables are connected to each other inside the quick disconnect unit which provides for easy cable disconnection and removal. The sheave in the cable box is rotated by cable movement and mechanically causes the feedback shaft of the control to rotate. The sheave is springloaded to the nozzle closed position.

4-31. **Torque Booster.** Fuel enters the torque booster through the inlet port, and flows through the filter element to the pressure regulating valve. The valve regulates fuel flow to maintain a servo pressure of approximately 160 psi above return pressure. The fuel is then routed to the interior of the power piston. Rotating the booster input shaft and shaft gear sector moves the pilot valve. This ports servo fuel to one end of the power piston and vents the other end of the piston to return pressure. The resulting pressure differential continues to move the piston until a hydraulic null relationship is established.

4-32. **Engine Master Switch.** The engine master switches control power to the main ignition switches and start selector switch. The master switches also operate in conjunction with the throttle cutoff switches to control the operation of the engine manifold shutoff valves. The engine manifold shutoff valve opens, permitting fuel to flow to the engine main fuel pump and to the main fuel control, when the engine master switch is placed in the ON position and the forward cockpit throttle lever is moved out of the OFF position. Placing the forward cockpit

throttle lever in the OFF position, or positioning the engine master switch to OFF closes the engine manifold shutoff valve. Placing the engine master switch in the OFF position closes the engine manifold shutoff valve regardless of throttle lever position. The master switch controls operation of various fuel system components along with providing a ground circuit for the battery relay. Placing the engine master switch in the ON position energizes the battery relay connecting the battery to the essential 28 Vdc bus.

4-33. **Throttle Cutoff Switch.** The throttle cutoff switches are a part of the forward cockpit throttle quadrant assembly and are actuated by the throttle lever. Operation of the throttle cutoff switches is related to the engine master switches and is described in paragraph 4-32.

NOTES

1 62-12199 THRU 64-738 MICRO ADJUST UNIT IS IN 81L/R DOOR.

2 64-738 AND UP MICRO ADJUST UNIT IS IN 74 DOORS AND NOT ACCESSIBLE FOR THROTTLE RIGGING WITH ENGINE INSTALLED.

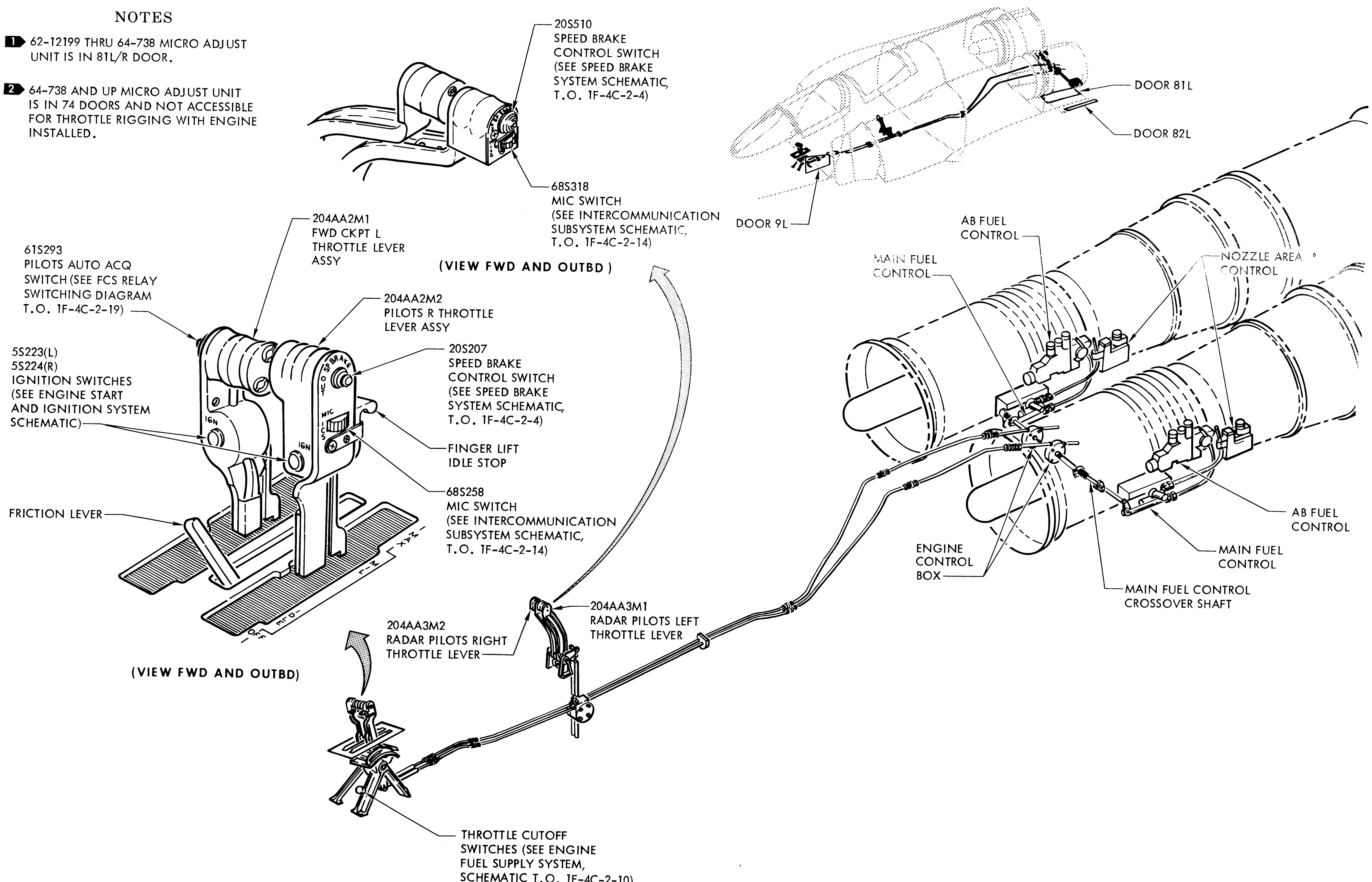


Figure 4-4. Airframe Power Plant Control Sys Schematic (Sheet 1 of 2)

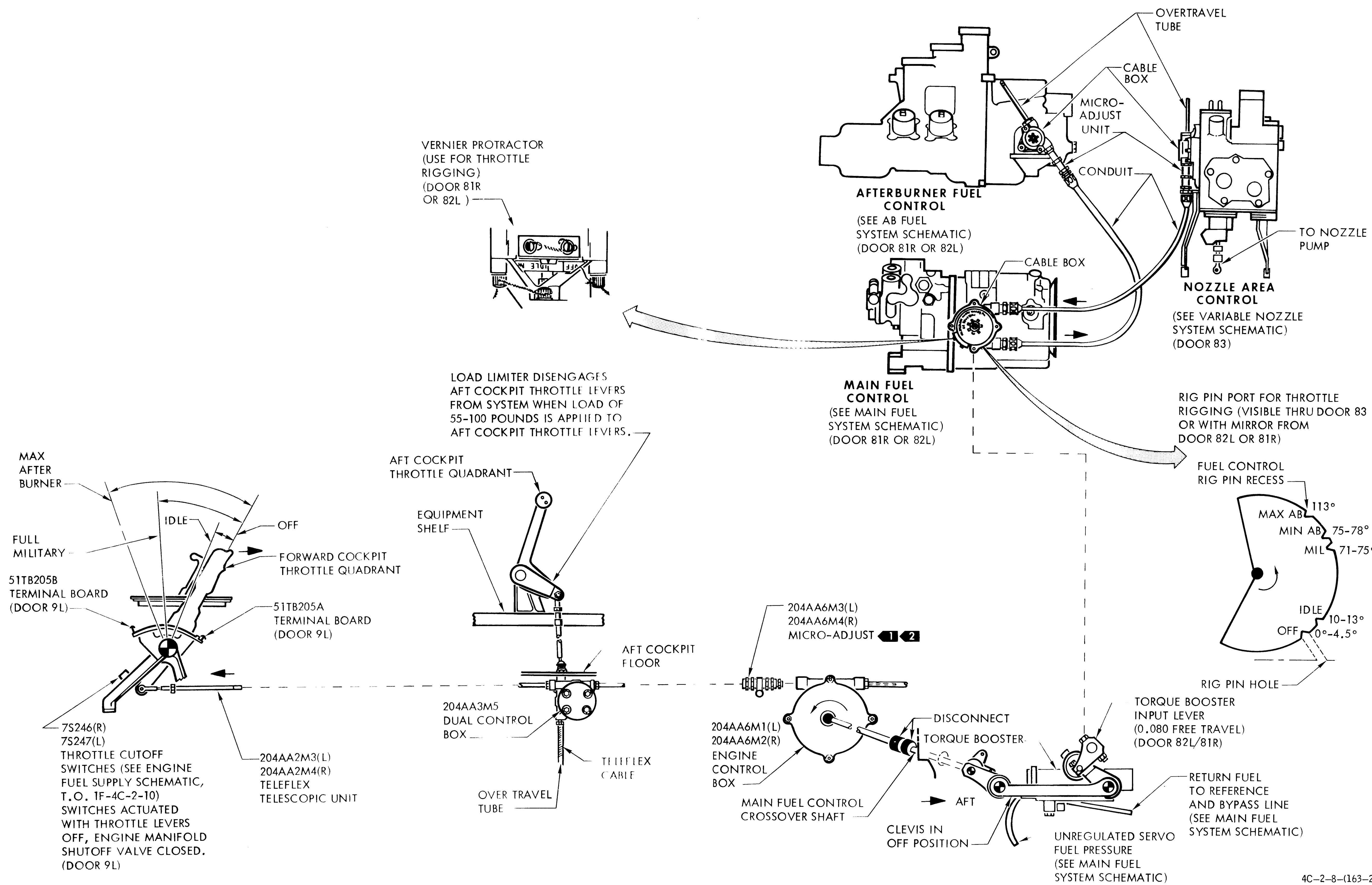


Figure 4-4. Airframe Power Plant Control System Schematic (Sheet 2 of 2)

TOOLS AND TEST EQUIPMENT

4-34. GENERAL.

4-35. The tools and equipment listed in table 4-2 should be used to perform the maintenance procedures presented in this manual. Alternate equipment with equal or greater range and accuracy than that stated in the Alternate Equipment column may be substituted. Number in parenthesis in the name column indicates quantity of items required.

4-36. **THROTTLE RIG TOOL.** See figure 4-5.

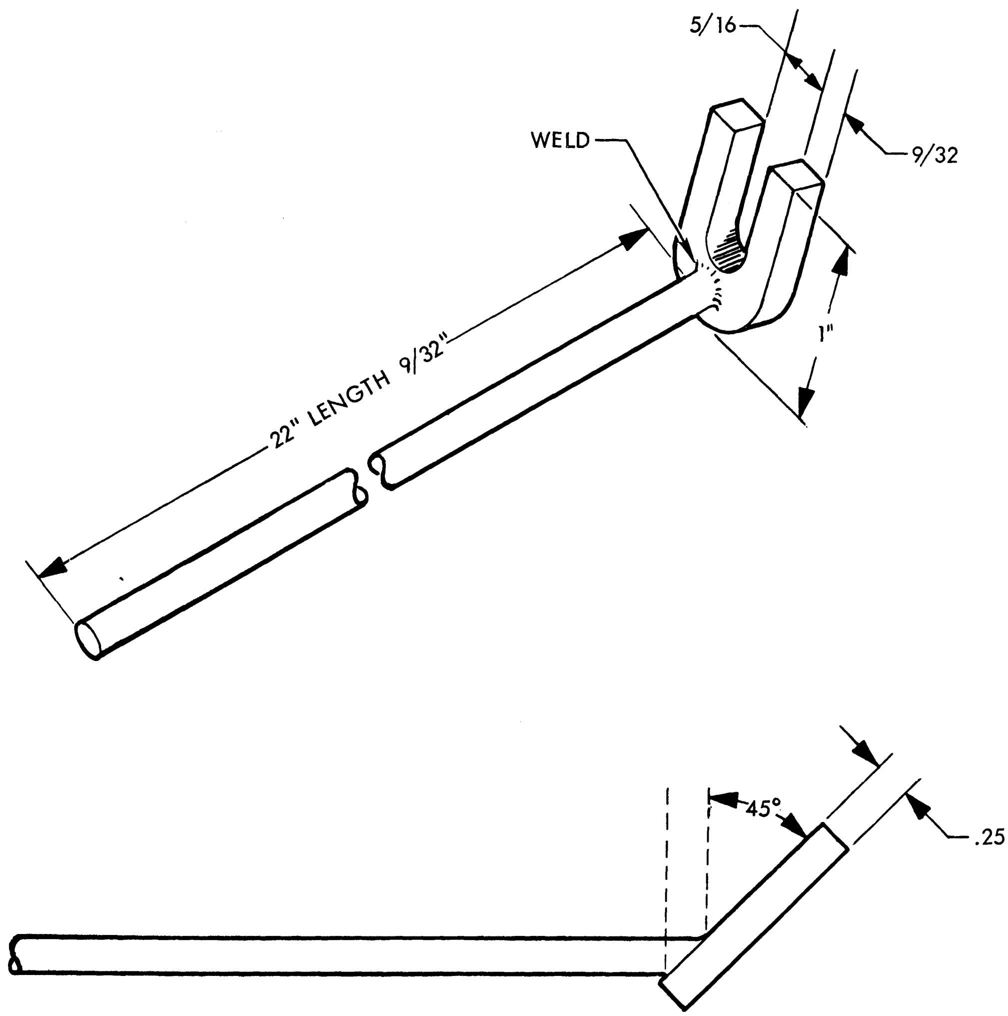
Table 4-2. Tools and Test Equipment

Name	Identification No.	Alternate Equip. Range	Alternate Equip. Accuracy	Use
Pin, rig	1C2754-13G2 (part of 1C2754G11)			To position the main fuel control during system rigging.
Screwdriver, throttle stop adjusting	MDT3209-301 or equivalent.			To adjust military stops in forward cockpit throttle quadrant.
Scale, spring		0 to 40 pounds		To check forward cockpit throttle levers shift breakout force.
Scale, spring		0 to 5 pounds		To check system friction.
Scale, push-pull		50 to 100 pounds		Check load limiters in aft cockpit throttle levers.
Adapter	1C2754-3G1 (part of 1C2754G11)			Used with torque wrench when checking torque required to rotate torque booster input shaft.
Multimeter	AN/PSM-6( )			Adjust throttle cutoff switches.
Safety strut, auxiliary air door	MDE3253-301 or 32E050034-1			Safety strut for auxiliary air door actuator.
Tester, flight line	1C2994G2A			Monitor throttle lever position during flight line trouble analysis.
Tester, pressure readout	1C2995G3			Flight line trouble analysis aid.
Borescope	MIL-L-4042B			To visually inspect cable drive wheel of dual control throttle box.
Power source, external electrical	M32A60	200/115 Vac 400 cps, 3Ø		Supply external electrical power to aircraft.

CONTINUED

Table 4-2. Tools and Test Equipment

Name	Identification No.	Alternate Equip. Range	Alternate Equip. Accuracy	Use
Tool, throttle rig	local manufacture (see fig 4-5)			To check outer slider and swivel nut clearance.
Scale, spring		0 to 10 pounds		Check friction of engine control box universals.
Wrench, torque		0 to 50 inch -pounds	±2%	
Wrench, torque		0 to 100 inch-pounds	±2%	
Guard, air duct	MDE32786-301 or 32E390046-301			L. Engine ground operation.
Guard, air duct	MDE32786-302 or 32E390046-302			R. Engine ground operation.
Set, rigging	1C2754G11			Control rigging.
Pressurizing unit, variable vane (JP-4 or JP-5 fuel)	1C3568G1			Variable vane and throttle system rigging.
Pressurizing unit, nozzle actuator (MIL-L-7808 oil)	1C3569G1			Nozzle rigging.
Fuel pressure source, torque booster	53E390214-1			Throttle rigging.
Scale, spring		0 to 200 pounds		Rigging engine control.
Wrench, torque		0 to 200 inch-pounds		Torque booster installation
Tool, torque booster input lever centering	local manufacture (see fig 4-6)			To center torque booster input lever during dry rigging of throttle
Analyzer, Jetcal	BH112J or BH112JA			Temperature and speed adjustment
Analyzer/Trimmer, Jetcal	BH112JB-40			Temperature and speed adjustment
Accessories, BH112JB- 40 Jetcal Analyzer/Trimmer	See fig 2-27A			



MATERIALS
STEEL BAR ALLOY (4140) FED SPEC, MIL-S-5626 FSN 9510-596-2178 QUANTITY REQUIRED 1" X 2"
TOOL STEEL ROUND FED SPEC, QQ-T-570 COND A FSN 9510-640-4291 QUANTITY REQUIRED 22"

NOTE

SUBSTITUTION OF ANY WELDABLE AND CORROSION RESISTANT STEEL IS AUTHORIZED.

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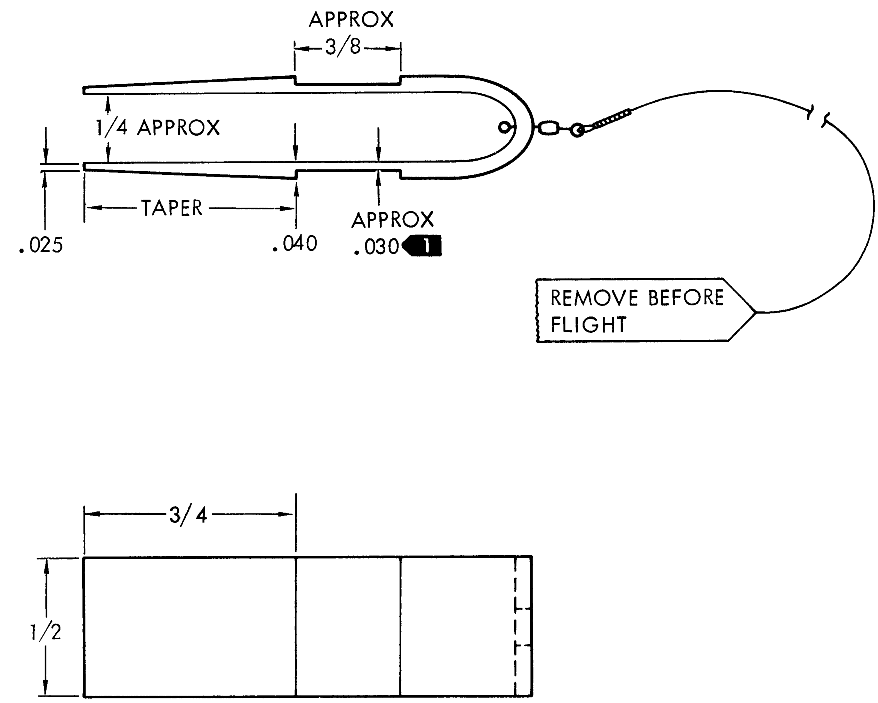
Figure 4-5. Throttle Rig Tool



NOTES

1. UNDERCUT PROVIDES GO-NO-GO CAPABILITY FOR CHECKING TORQUE BOOSTER STOP SCREW ADJUSTMENT. IF TOOL ENTERS TO THIS POINT TORQUE BOOSTER SHOULD BE REPLACED. IF STOP SCREWS ARE SO CLOSE THAT TOOL CANNOT BE INSERTED, TORQUE BOOSTER SHOULD BE REPLACED.

2. ALL DIMENSIONS IN INCHES.

3. FABRICATE FROM 0.040 STAINLESS STEEL OR ANY CORROSION RESISTANT STEEL.

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Figure 4-6. Torque Booster Input Lever Centerline Tool

AIRCRAFT MAINTENANCE

4-37. GENERAL INFORMATION.

4-38. **CIRCUIT BREAKERS.** The only circuit breakers, directly related to the airframe power plant control systems is the main fuel control circuit breakers. Refer to section II.

4-39. **MAINTENANCE CONCEPT.** Organizational maintenance on engine control systems consists of checking operation of the system, isolating a failure of a component, adjustment of engine idle and military rpm, EGT, and specific gravity of the main and afterburner fuel controls, rigging of the linkages and replacement of these components.

4-40. **TORQUE VALUES.** Critical and nonstandard torque values are included in each procedure where applicable. For standard torque values, refer to T.O.1F-4C-2-36.

4-41. REMOVAL, INSTALLATION AND ADJUSTMENT.

4-42. **FORWARD COCKPIT THROTTLE QUADRANT REMOVAL AND INSTALLATION.** See figure 4-7.

4-43. **Tools and Equipment.**

Scale, spring, 0 to 5 pounds

4-44. **Materials.**

Sealer, MIL-S-7502, Class A-4
Pin, cotter, MS24665-134

4-45. **Manpower Requirements.**

a. Two men required.

4-46. **Removal.**

a. Remove center engine control panel.

b. Remove inboard and outboard engine control panel as follows:

(1) Release fasteners and lift panel up.

(2) Disconnect bundle plugs and stow wire bundles and plugs so as not to interfere with quadrant removal.

c. Remove engaging controller and intercom panels. Loosen oxygen regulator panel and lift up for additional clearance during quadrant removal.

d. Remove left console cover panel.

e. Remove door 9L.

f. Remove door 6L and remove bleed air duct (1) from equipment refrigeration unit. Refer to T.O.1F-4C-2-7 to gain access to quadrant mounting bolts (see detail C).

g. Remove terminal board covers and disconnect wires from terminal boards.

h. Disconnect throttle cutoff switch wiring from quadrant and remove switches from mounting bracket.

i. Remove fore and aft terminal boards and aft terminal board mounting plate by removing bolts (3) and (5).

j. To eliminate adjustment of teleflex cables if cables are not being removed, place levers in IDLE position. Measure and record distance between outer slider and swivel nut (see detail B).

k. Remove two bolts (2) that attach telescopic unit rod ends to throttle levers (see view A-A). Do not loosen rod end jam nut or telescopic unit lock plug. Insert lockwire through rod ends so rod ends and cables cannot be rotated.

l. Disconnect wire bundle clamps from inboard and outboard side of quadrant.

m. Remove eight quadrant mounting bolts (4) from supports (see detail B and view AA). Note position of shims and retain shims for reinstallation.

n. Disconnect bundle clamp located just below fuel control panel on large wire bundle that runs along inboard side of quadrant.

o. Move large wire bundle inboard and then raise quadrant. Then move wire bundle outboard and under inboard support legs.

p. Insert aluminum strips between outboard support legs and insulation blankets.

q. Force quadrant inboard and up until outboard support legs are clear of structure. Rotate quadrant and remove from console.

r. To completely disassemble throttle quadrant, refer to Forward Cockpit Throttle Quadrant Assembly and Adjustment.

4-47. **Installation.**

a. Assure quadrant is properly assembled and adjusted, refer to Forward Cockpit Throttle Quadrant Assembly and Adjustment.

b. Remove both terminal boards from quadrant. Also remove aft terminal board mounting plate.

c. With engine control panels removed from console, install quadrant assembly through top of console. Position quadrant in console so inboard support legs are resting on top of large wire bundle.

d. Insert aluminum strips between outboard support legs and insulation blankets.

e. Force support legs between structural members and position as far outboard as possible.

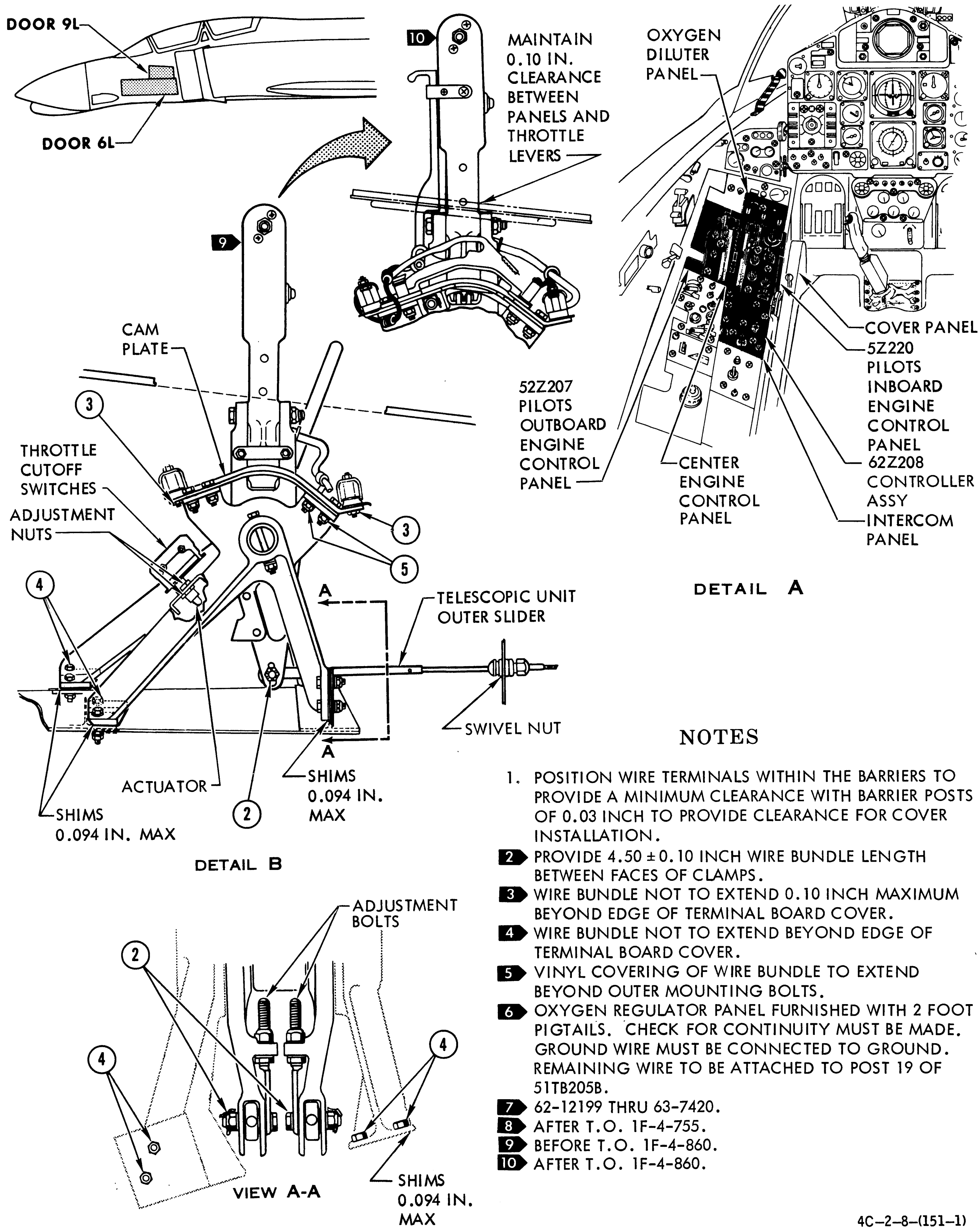
f. Move wire bundle inboard from under support legs and move quadrant down into position.

g. Reinstall shims and then install one mounting bolt in each of inboard support legs and forward outboard leg.

h. Temporarily install inboard, center, and outboard engine control panels and then move both throttle levers and the friction lever throughout entire range of travel and check for adequate clearance. Clearance between right throttle lever and inboard engine control panel must be a minimum of 0.10 inch. Remove layers of shims as required to move levers inboard or outboard.

i. Apply a coat of sealer in area of holes in the cockpit floor after correct shim thickness is determined. Install all mounting bolts.

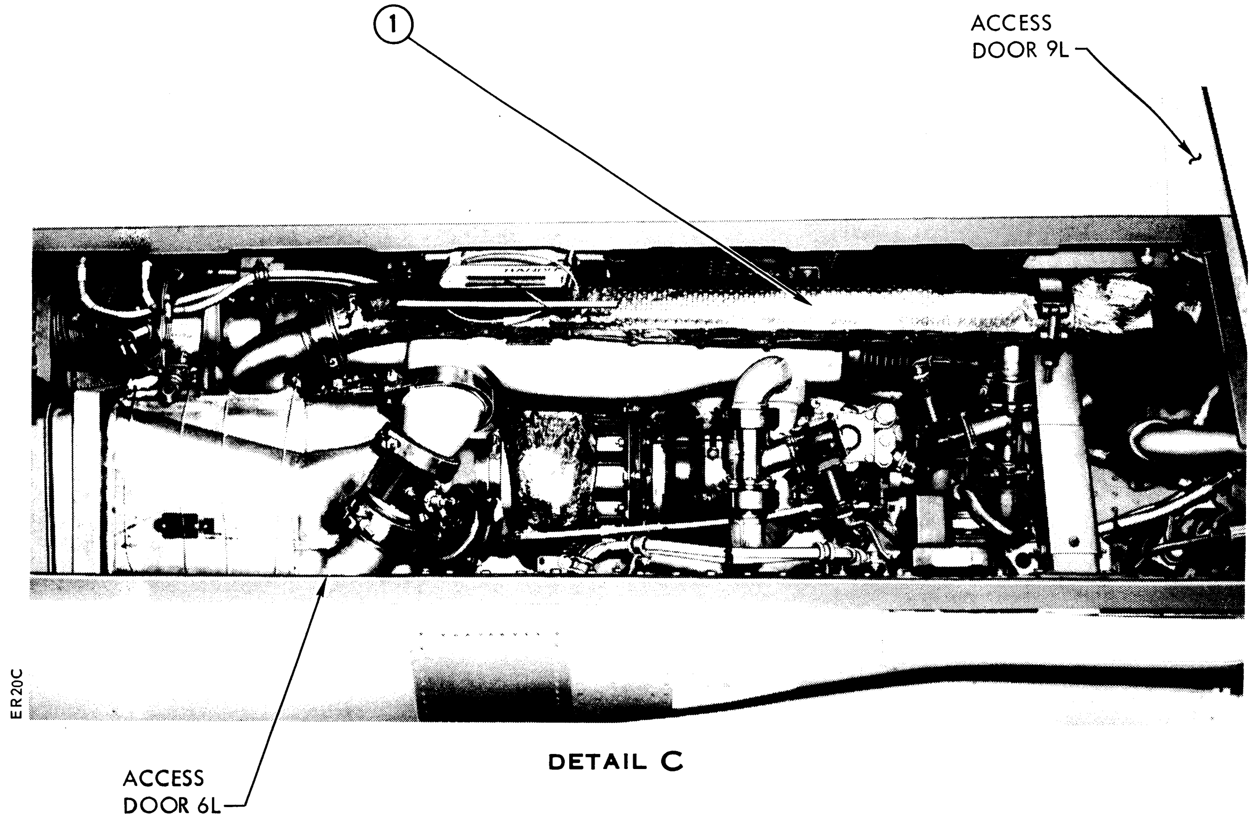
j. Shim aft outboard support as required and install mounting bolts. Remove engine control panels. Maximum



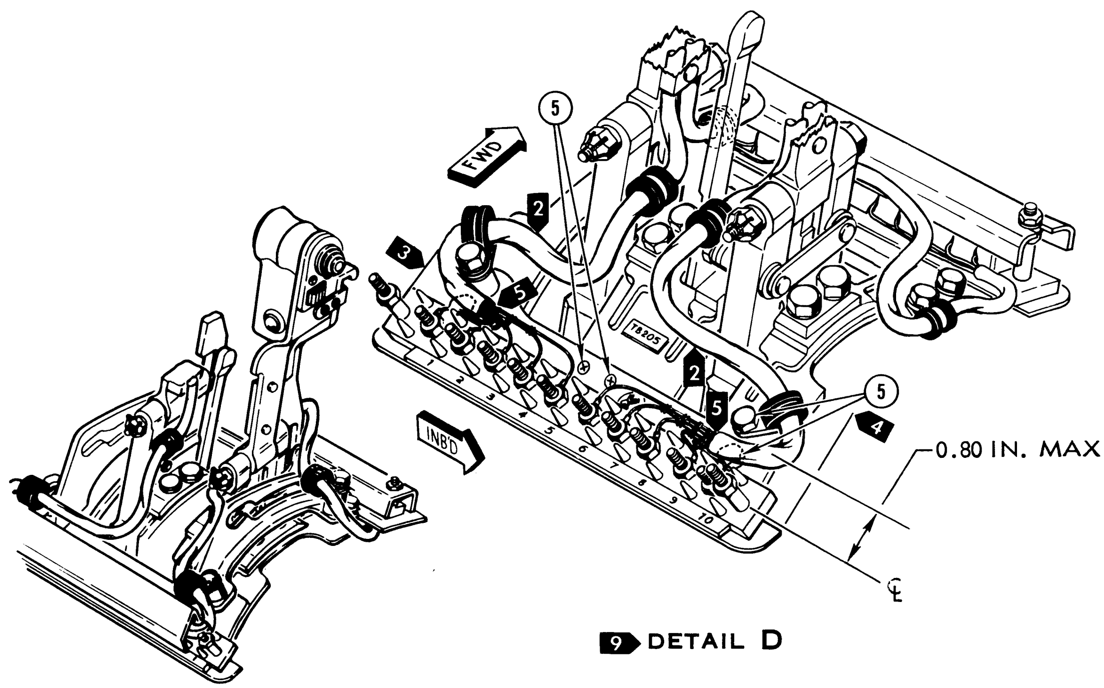
NOTES

1. POSITION WIRE TERMINALS WITHIN THE BARRIERS TO PROVIDE A MINIMUM CLEARANCE WITH BARRIER POSTS OF 0.03 INCH TO PROVIDE CLEARANCE FOR COVER INSTALLATION.
2. PROVIDE 4.50 ± 0.10 INCH WIRE BUNDLE LENGTH BETWEEN FACES OF CLAMPS.
3. WIRE BUNDLE NOT TO EXTEND 0.10 INCH MAXIMUM BEYOND EDGE OF TERMINAL BOARD COVER.
4. WIRE BUNDLE NOT TO EXTEND BEYOND EDGE OF TERMINAL BOARD COVER.
5. VINYL COVERING OF WIRE BUNDLE TO EXTEND BEYOND OUTER MOUNTING BOLTS.
6. OXYGEN REGULATOR PANEL FURNISHED WITH 2 FOOT PIGTAILS. CHECK FOR CONTINUITY MUST BE MADE. GROUND WIRE MUST BE CONNECTED TO GROUND. REMAINING WIRE TO BE ATTACHED TO POST 19 OF 51TB205B.
7. 62-12199 THRU 63-7420.
8. AFTER T.O. 1F-4-755.
9. BEFORE T.O. 1F-4-860.
10. AFTER T.O. 1F-4-860.

Figure 4-7. Forward Cockpit Throttle Quadrant Removal and Installation (Sheet 1 of 3)



DETAIL C



9 DETAIL D

10 DETAIL D

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Figure 4-7. Forward Cockpit Throttle Quadrant Removal and Installation (Sheet 2 of 3)

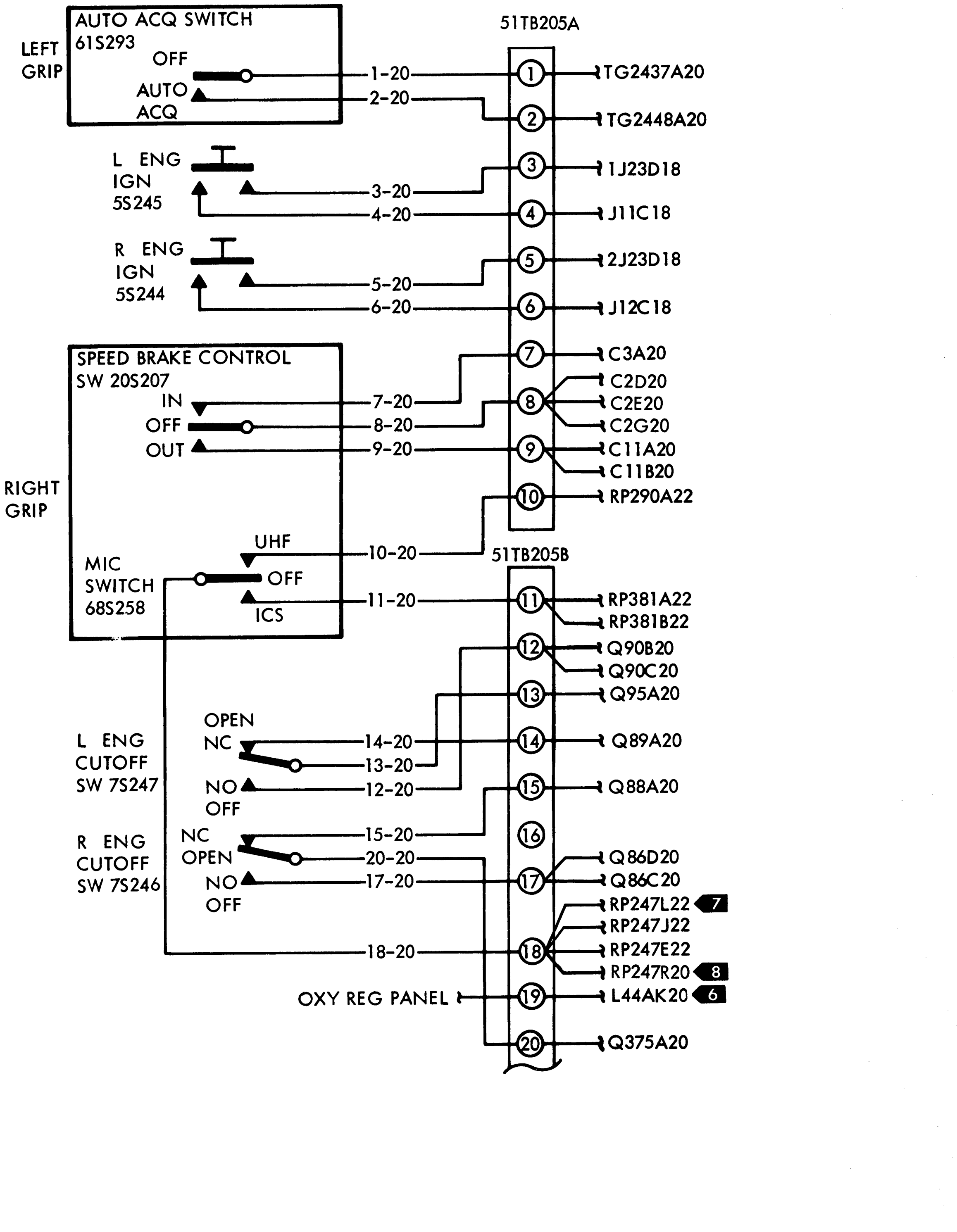


Figure 4-7. Forward Cockpit Throttle Quadrant Removal and Installation (Sheet 3 of 3)

one 0.094 inch shim at each location.

k. With friction lever set full aft check load at grip of each lever with scale to assure a load of zero to 1/2 pound will move the levers between IDLE and MIL. If load is in excess of 1/2 pound, check installation of shims and mounting bolts for possible warpage that may have been induced in quadrant during installation.

l. Install bleed air duct to equipment refrigeration unit. Refer to T.O.1F-4C-2-7 and install door 6L.

m. Attach telescopic unit rod ends to throttle levers and place levers in IDLE position. Move adjustment bolts (see view A-A) up or down to obtain dimensions recorded in step j during removal. If teleflex cables were removed or rod end jamnuts or telescopic unit lock plugs loosened, adjust teleflex cable. Refer to paragraph 4-115.

NOTE

Telescopic unit rod end attaching bolts must be installed with heads together (see view A-A).

n. *Install cotter pins in rod end attaching bolts.*

o. Install throttle cutoff switches to mounting bracket.

CAUTION

To prevent possible electrical short circuits, perform a FOD check of terminal board areas before installing terminal board covers.

p. Install fore and aft terminal boards and attach wires to terminal boards (see details D and E). Install terminal board covers. Attach all bundle clamps.

q. Adjust throttle cutoff switches. Refer to paragraph 4-80.

r. Perform ignition system operational check; refer to section III.

s. Perform system checks as follows:

(1) Auto acquisition switch, refer to T.O.1F-4C-2-19.

(2) Engine manifold shutoff valve, refer to T.O.1F-4C-2-10.

(3) Intercommunications subsystem, refer to T.O.1F-4C-2-14.

(4) Speed brakes, refer to T.O.1F-4C-2-4.

NOTE

Perform a thorough foreign object check of area before installing panels.

t. Install all console panels.

u. Install access door 9L after completing quality assurance inspection.

v. Install cover panel on inside of console.

w. Perform engine checkout. Refer to section II.

4-48. *Quality Assurance Summary.*

a. *Cotter pins installed in rod end attaching bolts.*

b. *Assure area has been thoroughly cleaned.*

c. *Terminal board covers installed.*

d. *Check for possible chafe points.*

e. *Engine control panels properly installed.*

f. *All operational checks performed.*

4-49. AFT COCKPIT THROTTLE QUADRANT.

4-50. Tools and Equipment.

Wrench, torque, 0 to 50 inch-pounds
Scale, spring, 0 to 5 pounds

4-51. Materials.

Pin, cotter, MS24665-134

4-52. Removal.

a. Place both generator control switches in forward cockpit OFF.

b. Remove following:

(1) Remove radar set control panel from aft cockpit left console. Refer to T.O.1F-4C-2-20.

(2) Remove central control panel. Refer to T.O.1F-4C-2-14.

c. Remove brush panel from between throttle levers and then remove remaining portion of aft throttle panel.

d. Remove small panel just aft of throttle panel.

e. Remove forward cover panel from inside of left console.

f. Remove autopilot amplifier. Refer to T.O.1F-4C-2-16.

g. Remove ARBCS rate gyro mounting bracket. Refer to T.O.1F-4C-2-17.

h. Remove bolts that attach telescopic units to bellcranks.

NOTE

Install wire through telescopic units rod ends to prevent rotation of telescopic rod ends and teleflex cables. Rotating telescopic unit rod end changes telescopic unit and teleflex cable adjustment.

i. Disconnect quadrant assembly wire bundle plug.

j. Remove four bolts that attach quadrant assembly to supporting structure.

NOTE

Retain laminated shims for installation use as required.

k. Lift quadrant assembly up and swing supports forward until supports are approximately horizontal.

l. While holding supports horizontal, move levers slightly aft and then rotate entire assembly inboard at bottom. Remove entire quadrant assembly through inside of console.

4-53. **Installation.**

a. Hold quadrant assembly up by levers and swing supports up to horizontal position.

b. Insert quadrant assembly, levers first, through inside of console.

c. Rotate quadrant up through console with levers positioned slightly aft.

d. Hold quadrant up and allow supports to swing down (vertical).

NOTE

Add laminated shims (max. 0.094 per quadrant assembly) to obtain required clearance between throttle lever and throttle panel.

e. Place quadrant assembly on supporting structure and install mounting bolts. *Torque mounting bolts 20 to 25 inch-pounds.*

f. *Connect quadrant assembly bundle plug.*

g. Utilize scale to check throttle lever friction throughout entire range of travel. *Lever friction must be less than 0.25 lb when measured at hand grip.*

h. Position rod ends of telescopic units in the bellcranks and install bolts.

i. *Install cotter pins.*

NOTE

When conditions specified in steps j thru l are not met, adjust the short section of teleflex cable connecting levers to aft cockpit control box, refer to paragraph 4-75.

j. *Position forward cockpit throttle levers at OFF and check aft cockpit throttle lever telescopic unit to swivel clearance for minimum of 0.25 inch.*

k. *Position forward cockpit throttle levers at OFF. Check that distance from center of aft cockpit throttle lever bellcrank bolts (point X; see figure 4-11) to equipment shelf is 2.20 $\pm$0.10 inches. Also, aft cockpit throttle lever knobs must align within 0.25 inch.*

l. *Position forward cockpit throttle lever at MAX A/B and check both aft cockpit telescopic units to assure that inner slide does not pass inspection hole of outer slide.*

m. Install ARBCS rate gyro and mounting bracket.

n. Install autopilot amplifier. Refer to T.O.1F-4C-2-16. Install cover panel on inside of left console.

o. Install following:

(1) Install radar set control panel. Refer to T.O.1F-4C-2-20.

(2) Install central control panel. Refer to T.O.1F-4C-2-14.

p. Install throttle panel and the small panel just aft of throttle panel.

4-54. *Quality Assurance Summary.*

a. *Autopilot amplifier, ARBCS rate gyro, and all control panels properly installed.*

4-55. **Adjustment.**

4-56. Adjustment of aft cockpit throttle quadrant assembly consists of establishing the proper relationship between aft cockpit telescopic units and the teleflex cables connecting quadrant to the control box and the forward cockpit throttle quadrant. Refer to paragraph 4-75 for adjustment of aft cockpit telescopic units and cables.

4-57. **TORQUE BOOSTER.**

4-58. **Tools and Equipment.**

Wrench, torque, 0 to 200 inch-pounds
Set, rigging
Wrench, torque, 0 to 50 inch-pounds

4-59. **Materials.**

Lockwire, MS20995NC32

4-60. **Removal.** See figure 4-8.

a. Open doors 81R and 82L.

b. Disconnect supply, return, and drain lines from booster.

c. Loosen bolts that attach booster output lever to main fuel control power shaft.

d. Remove bolts that attach booster bracket to main fuel control.

e. Remove booster and bracket.

f. Remove bracket from booster.

4-61. **Installation.** See figure 4-9.

a. Perform an airframe power control system rigging check. Refer to paragraph 4-115.

b. Close door 81R and 82L.

c. Perform engine checkout. Refer to section II.

4-62. **ENGINE CONTROL BOX.** See figure 4-10.

4-63. **Tools and Equipment.**

Wrench, torque, 0 to 50 inch-pounds
Wrench, torque, 0 to 100 inch-pounds
Safety strut, auxiliary air door

4-64. **Materials.**

Pin, cotter, MS24665-149

4-65. **Removal.**

WARNING

To prevent personnel injury assure strut is installed on door 81L/R actuators.

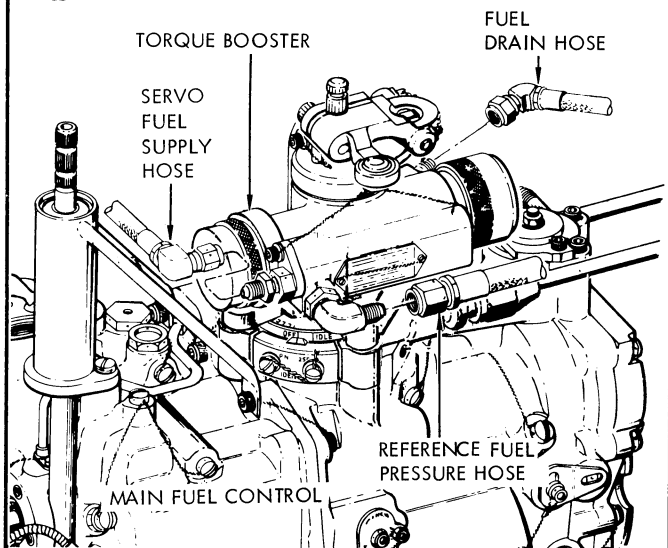
a. Install safety strut on door 81L/R and open door 82L.

REMOVAL

1 HOSES

a DISCONNECT THE SUPPLY, DRAIN AND REFERENCE PRESSURE HOSES AT THE TORQUE BOOSTER.

b CAP OR PLUG ALL OPEN PORTS.

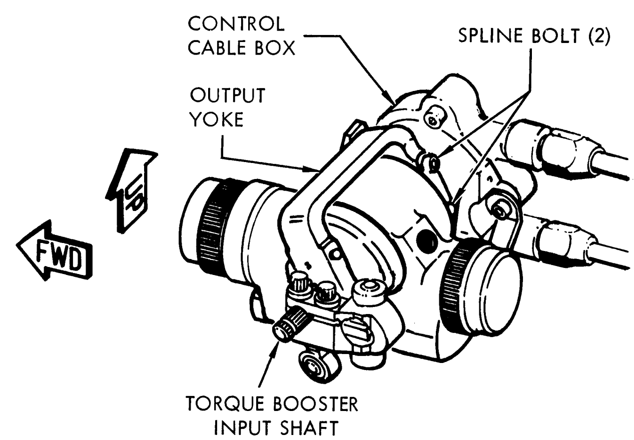


2 OUTPUT YOKE

Note

THE TWO SPLINE BOLTS ARE RIVETED TO PREVENT REMOVAL FROM THE OUTPUT YOKE.

a LOOSEN BUT DO NOT REMOVE THE TWO SPLINE BOLTS THAT CONNECT THE TORQUE BOOSTER OUTPUT YOKE TO THE MAIN FUEL CONTROL INPUT SHAFT.



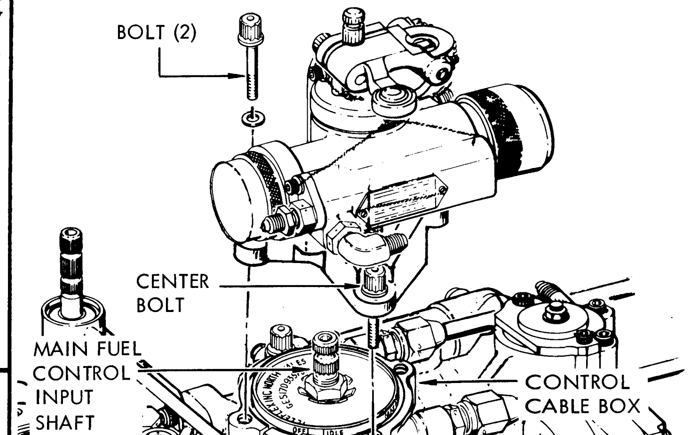
3 TORQUE BOOSTER

a SEPARATE THE TORQUE BOOSTER AND MOUNTING BRACKET FROM THE MAIN FUEL CONTROL CABLE BOX BY REMOVING THE THREE MOUNTING BOLTS AND WASHERS (THE CENTER BOLT CANNOT BE COMPLETELY REMOVED FROM THE MOUNTING BRACKET).

b REMOVE THE TORQUE BOOSTER AND MOUNTING BRACKET AS AN ASSEMBLY.

Note

IF ANY RIGGING IS TO BE PERFORMED, INSTALL THREE SLAVE BOLTS AND WASHERS TO HOLD THE CABLE BOX IN PLACE UNTIL THE TORQUE BOOSTER IS REINSTALLED.



4 COMPLETE DISASSEMBLY

a REMOVE THE UNION, REDUCER AND 90 DEGREE ELBOW FROM THE TORQUE BOOSTER.

b PLUG ALL OPEN PORTS.

c REMOVE THE FOUR MOUNTING BOLTS AND WASHERS SECURING THE MOUNTING BRACKET TO THE TORQUE BOOSTER.

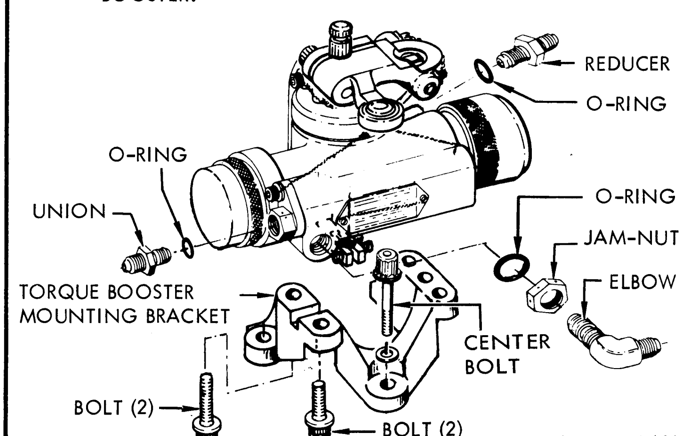


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Figure 4-8. Torque Booster Removal

INSTALLATION

1 UNIONS AND ELBOWS

Note

THE THROTTLE INPUT LINKAGE MUST BE RIGGED BEFORE THE TORQUE BOOSTER IS INSTALLED.

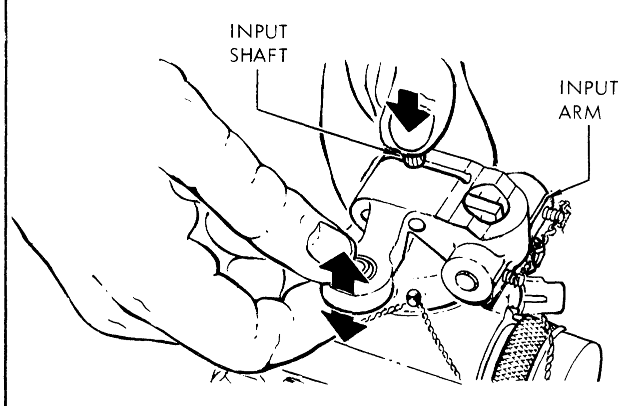
a INSPECT THE TORQUE BOOSTER INPUT ARM FOR LOOSENESS AS FOLLOWS:

(1) HOLD THE TORQUE BOOSTER IN ONE HAND WITH THE THUMB PRESSING DOWN ON THE INPUT SHAFT; HOLD THE INPUT ARM WITH THE OTHER HAND.

(2) GENTLY TRY TO ROCK THE INPUT ARM ON THE INPUT SHAFT. IF THE INPUT ARM MOVES ON THE SHAFT, SPLINE WEAR IS INDICATED AND THE TORQUE BOOSTER SHALL BE RETURNED TO OVERHAUL.

Note

THF INPUT ARM SPLINE SHAFT HAS A NORMAL MOVEMENT OF ABOUT 1/8 INCH INTO AND OUT OF THE TORQUE BOOSTER BODY. DO NOT CONFUSE THIS MOVEMENT WITH LOOSENESS OR SLIDING OF THE INPUT ARM ON THE INPUT SHAFT.

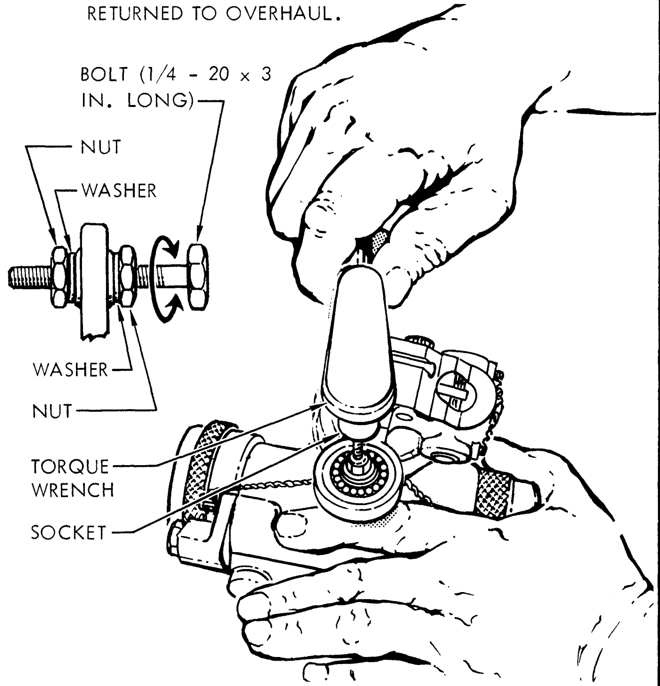


J79-B3583-5-A2A

b INSPECT THE TORQUE BOOSTER INPUT ARM BEARING AS FOLLOWS:

(1) **MEASURE AXIAL BEARING PLAY. IF IT EXCEEDS 0.010 INCH, THE TORQUE BOOSTER SHALL BE RETURN TO OVERHAUL.**

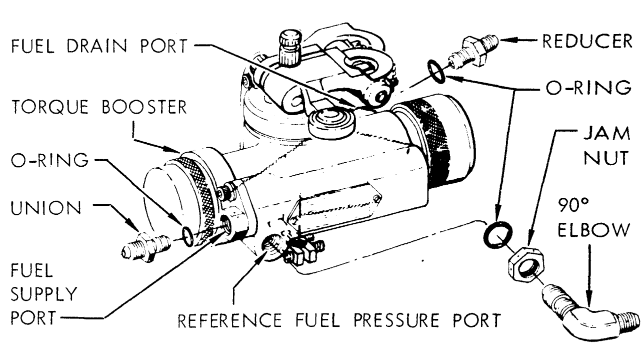
(2) IF THE TORQUE REQUIRED TO ROTATE THE BEARING ONE COMPLETE REVOLUTION EXCEEDS 3 LB-IN. AND/OR THERE IS NOTICEABLE BINDING OR ERRATIC MOTION, THE TORQUE BOOSTER SHALL BE RETURNED TO OVERHAUL.



c ASSEMBLE A NEW O-RING ON A UNION AND INSTALL IN THE FUEL SUPPLY PORT; TORQUE TO 135-150 LB-IN.

d ASSEMBLE A NEW O-RING ON A REDUCER AND INSTALL IN THE FUEL DRAIN PORT; TORQUE TO 40-50 LB-IN.

e ASSEMBLE A JAM NUT AND A NEW O-RING ON A 90 DEGREE ELBOW AND INSTALL IN THE REFERENCE FUEL PRESSURE PORT.



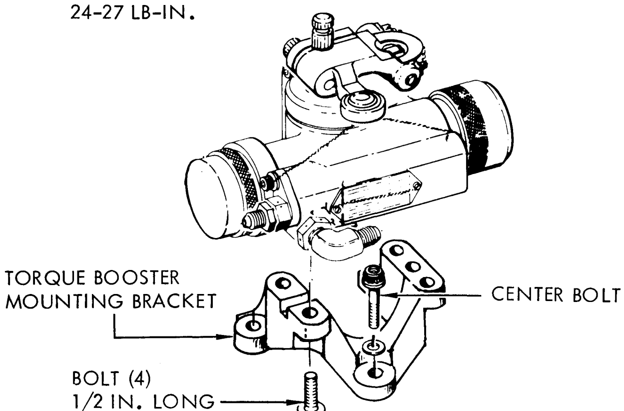
4C-2-8-(35-1)B

Figure 4-9. Torque Booster Installation (Sheet 1 of 3)

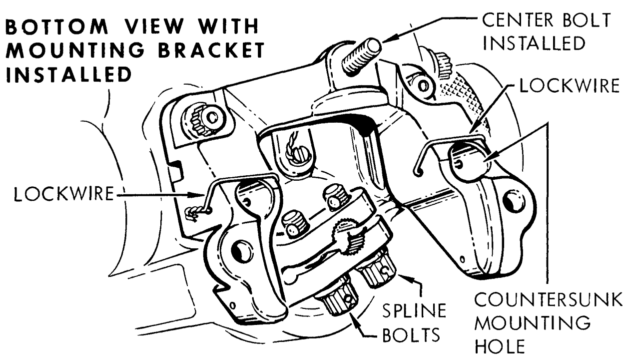
2 BRACKET

a PLACE A BOLT AND WASHER IN THE CENTER HOLE OF THE MOUNTING BRACKET. THE BOLT CANNOT BE INSTALLED AFTER THE MOUNTING BRACKET IS MOUNTED ON THE TORQUE BOOSTER.

b INSTALL THE MOUNTING BRACKET ON THE TORQUE BOOSTER WITH FOUR BOLTS. TORQUE THE BOLTS TO 24-27 LB-IN.

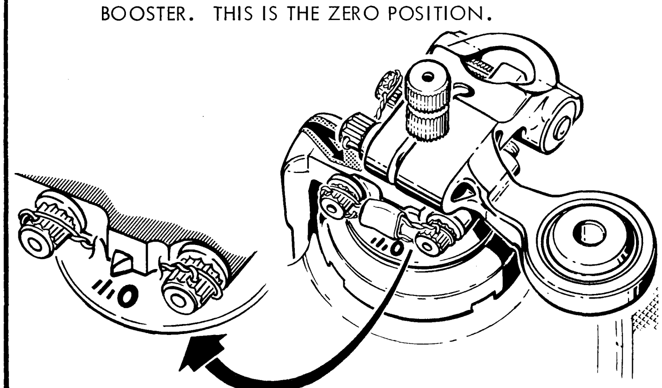


c LOCKWIRE THE TWO BOLTS INSTALLED IN THE COUNTERSUNK MOUNTING HOLES AS SHOWN.



d LOOSEN THE TWO SPLINE BOLTS ON THE TORQUE BOOSTER OUTPUT YOKE.

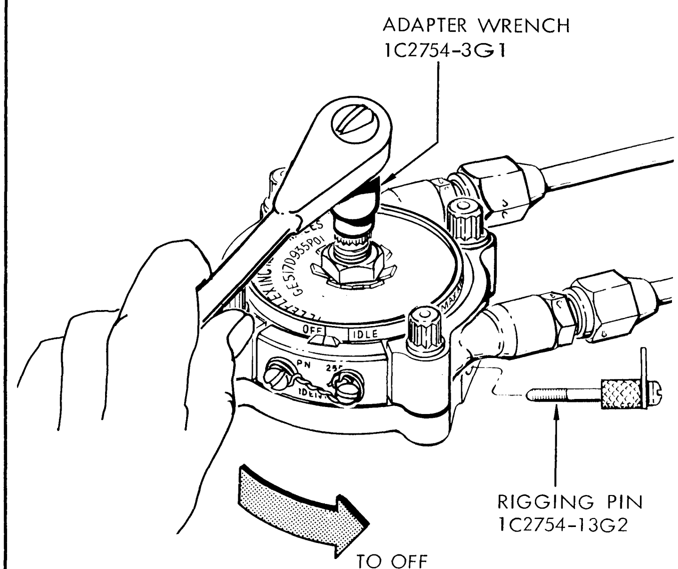
e ROTATE THE INPUT ARM ON THE TORQUE BOOSTER COUNTERCLOCKWISE UNTIL THE POINTER IS ALIGNED WITH THE LONG CENTER MARK ON THE TORQUE BOOSTER. THIS IS THE ZERO POSITION.



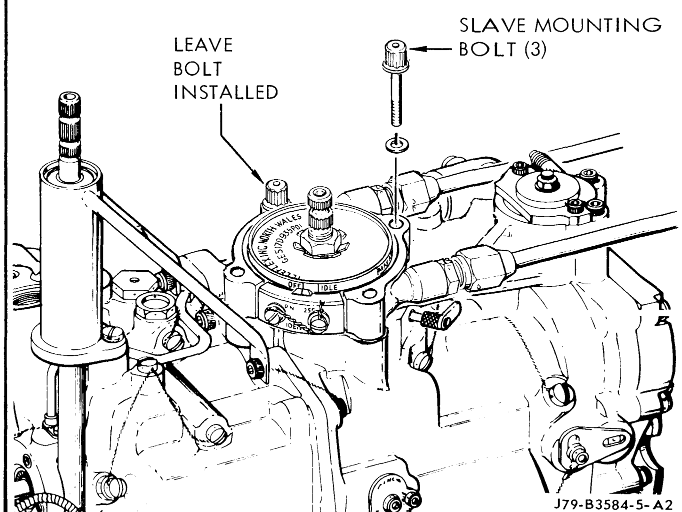
3 MAIN FUEL CONTROL SHAFT POSITIONING

a ROTATE THE THROTTLE INPUT SHAFT ON THE MAIN FUEL CONTROL TO THE OFF POSITION, AGAINST THE STOP IN THE CONTROL, WITH ADAPTER WRENCH, 1C2754-3G1.

b THREAD RIGGING PIN, 1C2754-13G2, INTO THE RIGGING PORT. IF THE PIN IS PROPERLY ENGAGED, THE SHAFT WILL NOT ROTATE.



c REMOVE THE THREE SLAVE MOUNTING BOLTS AND WASHERS FROM THE CABLE BOX ON THE MAIN FUEL CONTROL. LEAVE THE BOLT NEAREST THE COMPRESSOR CASE INSTALLED.



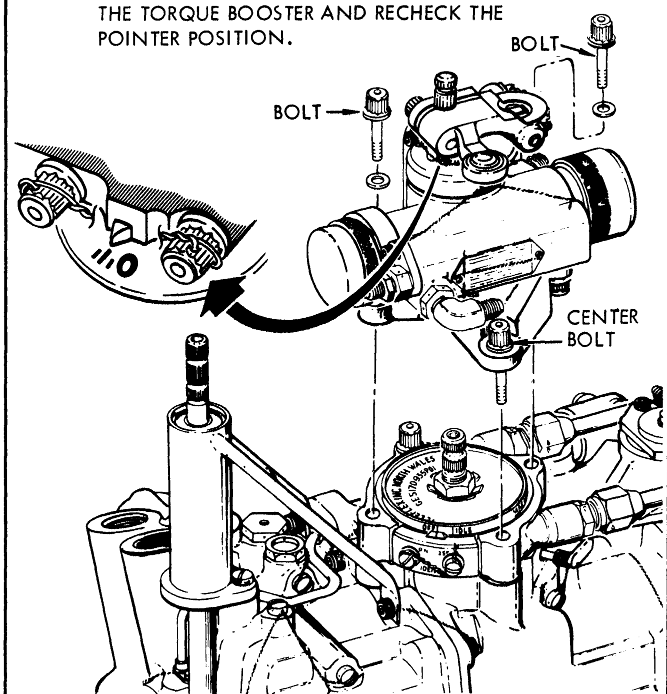
4C-2-8-(35-2)A

Figure 4-9. Torque Booster Installation (Sheet 2 of 3)

4 TORQUE BOOSTER

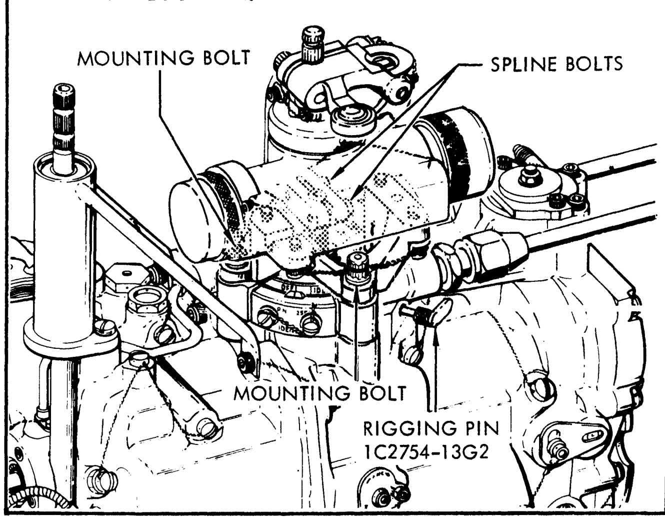
a POSITION THE TORQUE BOOSTER ON THE MAIN FUEL CONTROL AND SECURE WITH THREE BOLTS AND WASHERS (THE CENTER BOLT IS ALREADY IN POSITION). TIGHTEN THE BOLTS FINGERTIGHT.

b MAKE SURE THAT THE POINTER IS ALIGNED WITHIN THE SHORT MARKS ON EITHER SIDE OF THE LONG CENTER MARK. IF THE POINTER IS ALIGNED DIRECTLY WITH THE SHORT MARK BETWEEN THE LONG CENTER MARK AND THE ZERO, REMOVE THE TORQUE BOOSTER AND RESET THE POINTER TO ALIGN WITH THE SHORT MARK ON THE OTHER SIDE OF THE CENTER MARK. REINSTALL THE TORQUE BOOSTER AND RECHECK THE POINTER POSITION.



c TORQUE THE THREE MOUNTING BOLTS TO 24-27 LB-IN. AND LOCKWIRE.

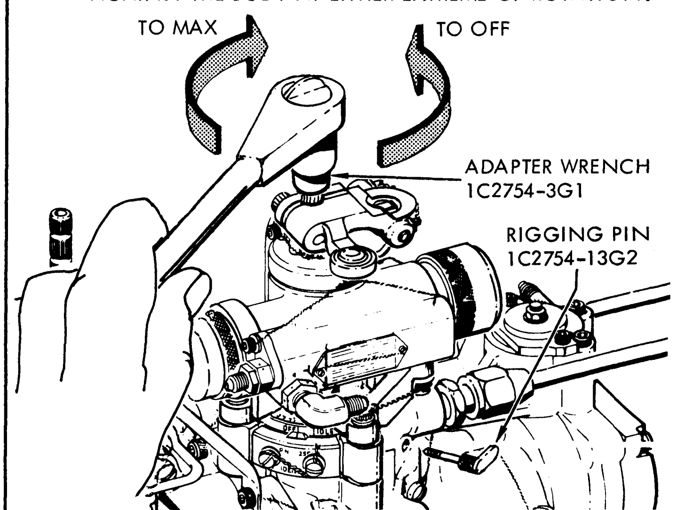
d TORQUE THE TWO SPLINE BOLTS TO 36-45 LB-IN. AND LOCKWIRE.



5 INSTALLATION CHECK

a REMOVE THE RIGGING PIN FROM THE MAIN FUEL CONTROL.

b ROTATE THE INPUT SHAFT ON THE TORQUE BOOSTER THROUGHOUT ITS FULL TRAVEL, FROM STOP TO STOP, CHECKING FOR FREEDOM OF MOVEMENT WITHOUT BINDING. ROTATIONAL TORQUE SHALL NOT EXCEED 40 LB-IN. THE OUTPUT YOKE SHOULD NOT BOTTOM AGAINST THE BODY AT EITHER EXTREME OF ROTATION.

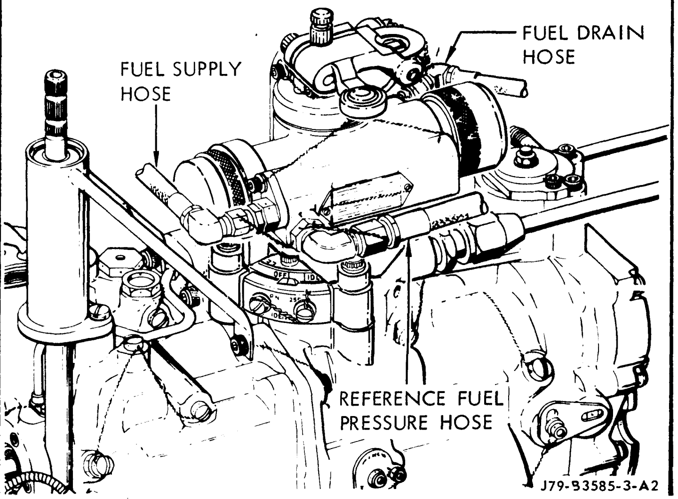


6 FINAL CONNECTIONS

a CONNECT THE FUEL SUPPLY HOSE TO THE UNION; TORQUE THE COUPLING NUT TO 135-150 LB-IN. AND LOCKWIRE.

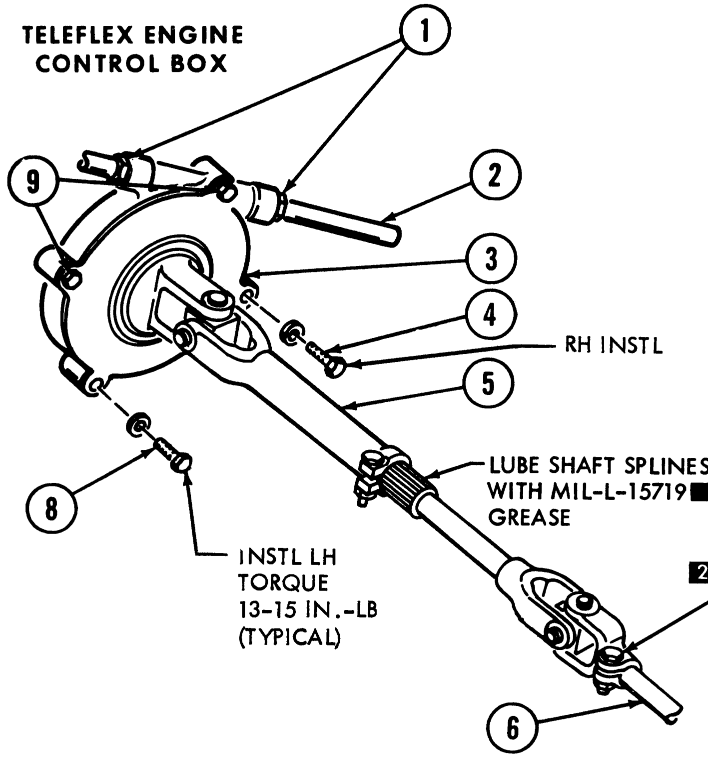
b CONNECT THE FUEL DRAIN HOSE TO THE REDUCER; TORQUE THE COUPLING NUT TO 135-150 LB-IN. AND LOCKWIRE

c CONNECT THE REFERENCE FUEL PRESSURE HOSE TO THE 90 DEGREE ELBOW; TORQUE THE COUPLING NUT TO 155-175 LB-IN; TORQUE THE ELBOW JAM NUT TO 155-175 LB-IN. LOCKWIRE THE JAM NUT TO THE COUPLING NUT.



4C-2-8-(35-3)A

Figure 4-9. Torque Booster Installation (Sheet 3 of 3)



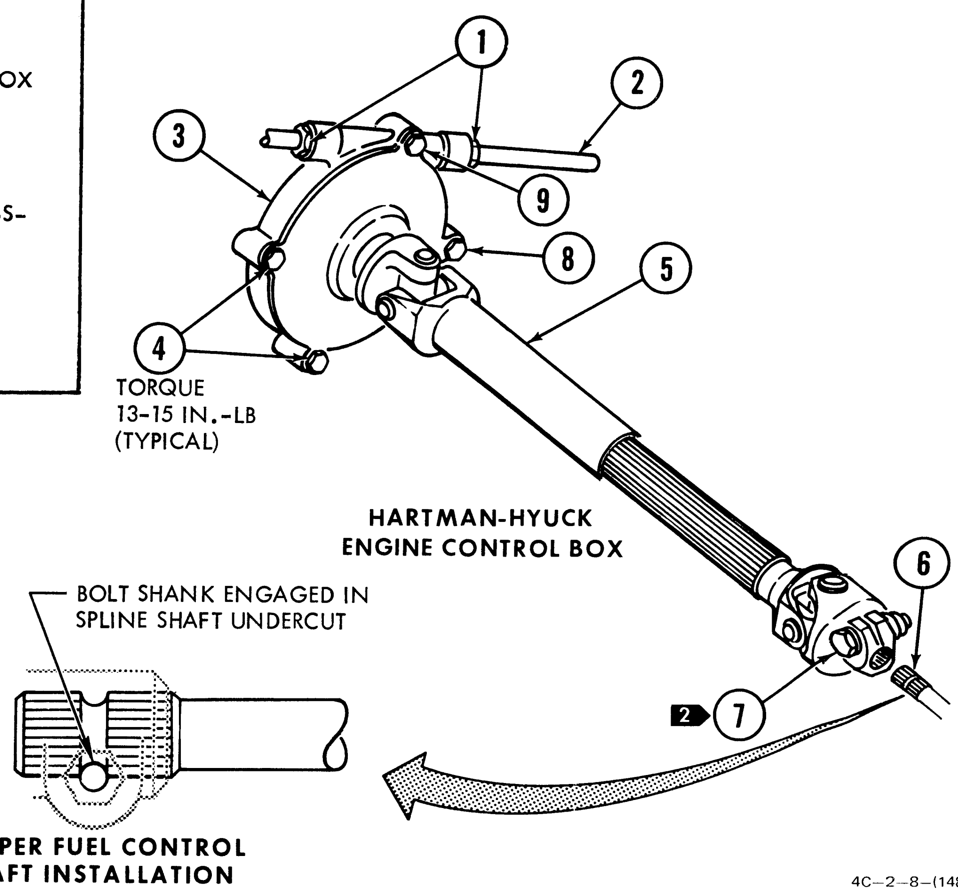
TELEFLEX CONDUIT TORQUE VALUES	
CONNECTOR NUT THREAD SIZE	TORQUE VALUE INCH-POUNDS
7/16 - 20	40-60
1/2 - 20	60-80
5/8 - 20	80-100

NOTES

1 LOCKWIRE WITH MS20995NC32 WIRE

2 AFTER T.O. 1F-4-849, SELF RETAINING BOLTS ARE INSTALLED IN THE CLEVIS FORK AND PAINTED BLUE (COLOR NO. 15102, MIL-STD-595 SPEC MIL-L-19537 OR EQUIVALENT) TO DENOTE CRITICAL AREA.

1. END FITTING
2. OVER TRAVEL TUBE
3. ENGINE CONTROL BOX
   204AA6M1 (L)
   204AA6M2 (R)
4. BOLT AND WASHER
5. TORQUE SHAFT
6. FUEL CONTROL CROSS-OVER SHAFT
7. SPLINE SHAFT BOLT
8. BOLT AND WASHER
9. BOLT AND WASHER
   (2 REQD)



4C-2-8-(148-1)A

Figure 4-10. Control Box Removal and Installation (Sheet 1 of 2)

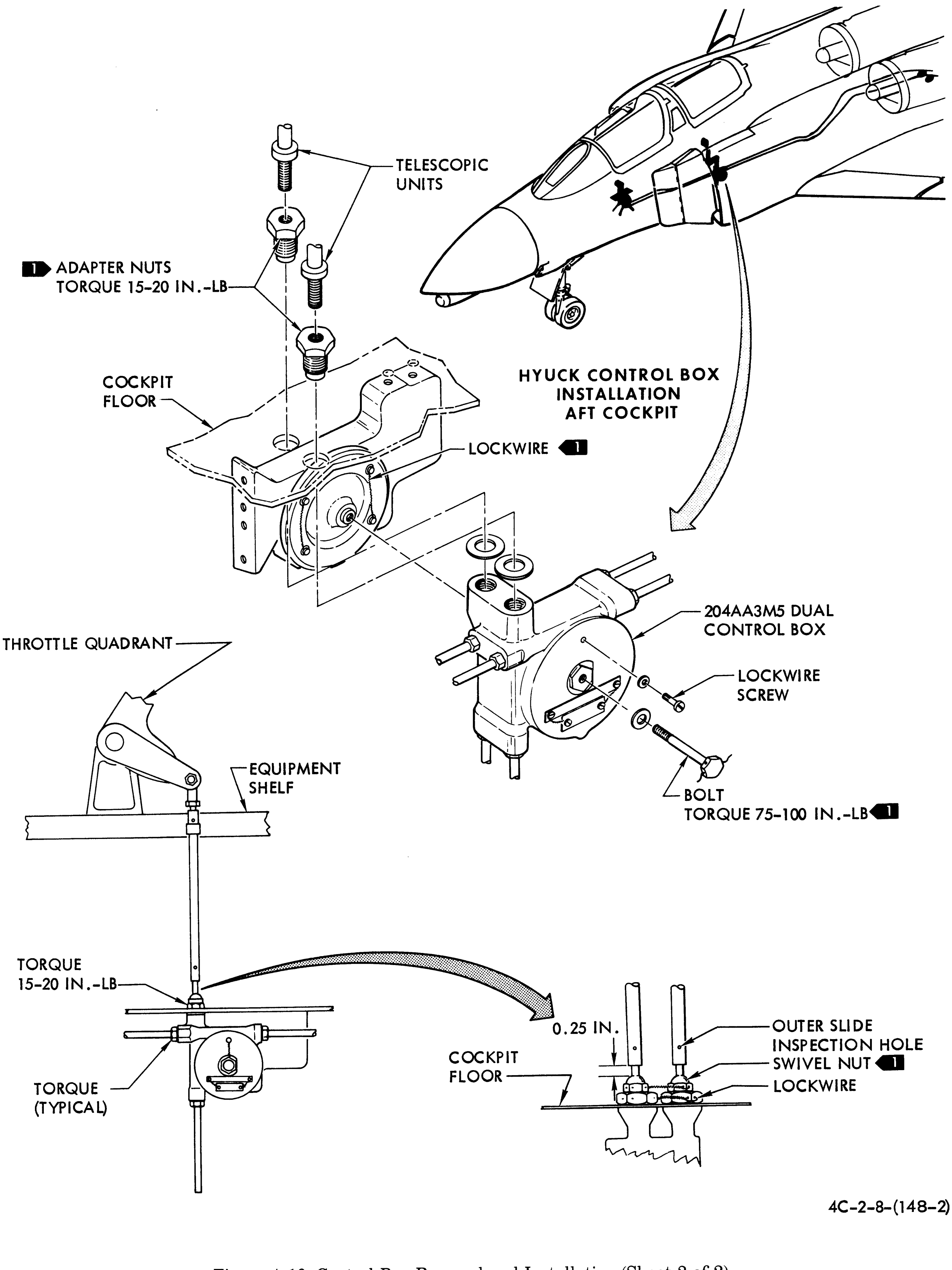


Figure 4-10. Control Box Removal and Installation (Sheet 2 of 2)

NOTE

Prior to removing left engine control box from aircraft, it may be necessary to remove some hydraulic lines which connect to auxiliary air door hydraulic selector valves above engine control box.

b. Position forward cockpit throttle lever in OFF.

c. Remove spline shaft bolt and disconnect engine control box torque shaft from main fuel control crossover shaft.

d. Remove overtravel tube from aft side of control box.

e. Disconnect conduit end fitting from forward side of control box.

f. Remove three mounting bolts.

CAUTION

Be careful not to kink teleflex cable.

g. Carefully move aft edge of control box away from structure and at same time rotate control box torque shaft counterclockwise (left installation) or clockwise (right installation) to remove control box from teleflex cable.

4-66. **Installation.**

a. Position forward cockpit throttle lever in OFF.

b. Insert teleflex cable into forward hole of control box.

c. Turn torque shaft in a clockwise direction to roll control box on teleflex cable.

NOTE

Rotate torque shaft in a clockwise direction when installing left control box and counterclockwise when installing right control box.

d. Place control box and teleflex conduit/cable in position on aircraft structure.

e. Install three mounting bolts and washers. There are four mounting holes in engine control box of which only three are used. When installing control box in left side, aft mounting hole is not used. When installing control box in right side, bottom mounting hole is not used. *Torque bolts 13 to 15 inch-pounds.*

f. *Connect conduit end fitting to forward side of control box and torque 40 to 60 inch-pounds.*

g. Position forward cockpit throttle lever in IDLE. Measure distance cable extends beyond centerline of control box. ***If cable does not extend 0.25 to 0.75 inches beyond outlet of control box, adjust teleflex cable.*** **Refer to paragraph 4—75.**

h. Install overtravel tube to aft side of control box. *Torque 40 to 60 inch—pounds and lockwire.*

i. *Perform an airframe power plant control system friction check refer to section II.*

j. *Rig airframe power plant control system; refer to paragraph 4-115.*

k. *Torque spline shaft 3/16 inch bolt 13 to 15 inch—pounds or 1/4 inch bolt 30 to 40 inch—pounds and install cotter pin.*

CAUTION

If hydraulic lines have been removed from auxiliary air door hydraulic selector valves prior to removal of left engine control box, assure all hydraulic lines have been properly connected to selector valves after installation of control box.

l. *Close door 82L.*

4-67. *Quality Assurance Summary.*

a. *Perform engine checkout. Refer to section II.*

4-68. **AFT COCKPIT DUAL CONTROL BOX.** See figure 4-10.

4-69. **Tools and Equipment.**

Wrench, torque, 0 to 50 inch-pounds

4-70. **Materials.**

Pin, cotter, MS24665-134
Lockwire, MS20995NC32
Sealer, MIL-S-7502, Class A-4
Compound, sealing, MIL-S-7126, Type I

4-71. **Removal.**

a. Remove cover panel from inside of aft cockpit left console and remove autopilot amplifier.

b. Remove radio receiver-transmitter. Refer to T.O.1F-4C-2-14.

c. Remove teleflex cables. Refer to paragraph 4-75.

d. Disconnect telescopic unit inner slides from control box in aft cockpit.

e. Cut lockwire and remove two hex nuts securing control box against floor in aft cockpit and then remove washers.

NOTE

Washers must be removed to allow control box to be shifted forward to disengage conduit. Washers stick to floor and will not allow the control box to shift forward because of cockpit pressurization sealer being applied.

f. Install plugs in control box ports that protrude through cockpit floor to prevent dirt from entering box during removal.

g. Remove Aero 7A launcher from forward left hand missile cavity. Refer to T.O.1F-4C-2-18.

h. Remove eight screws from wire bundle support directly below control box in missile cavity. Remove bottom portion of support and then remove top portion from above wire bundle.

i. Remove overtravel tubes from bottom side of control box.

j. Remove equipment cooling duct just below control box by removing clamps and shifting duct forward, and then aft. Refer to T.O.1F-4C-2-7.

k. Loosen bolts in conduit body connectors just ahead of control box. Slide connectors forward until conduit ends are visible.

l. Disconnect two sections of conduit from forward side

of control box.

m. Disconnect conduit end fittings from aft side of control box but do not attempt to disengage conduit from control box.

n. Remove nuts from control box mounting bolts.

o. Push mounting bolts out as far as possible, and then shift control box slightly outboard, down, then forward to disengage conduit.

NOTE

There are washers installed between control box and cockpit floor and it may be necessary to apply pressure from above to break them loose after having lowered control box slightly. If washers are not broken loose, it is difficult to remove control box.

p. Remove mounting bolts from control box.

4–72. **Installation.** (TELEFLEX)

a. Place one washer on each mounting bolt and install bolts in control box so they are flush with mounting surface.

b. Install two washers to control box that fit between control box and cockpit floor.

c. Brush on a coat of sealer in area of holes in cockpit floor.

d. Engage aft sections of conduit in control box and rotate control box into position.

e. Push mounting bolts through mounting bracket and install washers and nuts.

f. Connect conduit end fitting to aft side of control box. *Torque 40 to 60 inch–pounds.*

g. Connect two sections of conduit to forward side of control box and slide two conduit body connectors into position. *Tighten connector bolts.*

h. Install washers and install two hex nuts that tighten down against cockpit floor. *Torque nuts 40 to 60 inch–pounds and secure with lockwire. Install telescopic unit inner sliders, torque swivel nuts 15 to 20 inch–pounds, and secure with lockwire.*

i. Install teleflex cables. Refer to paragraph 4–75.

j. Install cooling duct below control box. Refer to T.O.1F-4C-2-7.

k. Install wire bundle support. *Assure four end screws engage and plates mounted on structure.*

l. Install Aero 7A launcher. Refer to T.O.1F-4C-2-18.

m. Install radio receiver–transmitter. Refer to T.O.1F-4C-2-14.

n. *Install autopilot amplifier and then install cover panel.*

4–73. **Installation.** (HARTMAN–HUYCK)

NOTE

If Teleflex box is being replaced with a Huyck box, the 170-1-103 mounting plate must be installed first.

a. Install large center bolt in control box.

b. Install washers between cockpit floor and control box.

c. Engage forward sections of conduit to control box and rotate control box into position.

d. Attach control box to mounting plate with center bolt. *Assure two bolts in cockpit floor line up with top holes of control box.*

e. *Attach forward conduit sections to control box and torque conduit fittings 40 to 60 inch–pounds.*

f. *Torque large center bolt 75 to 100 inch–pounds and lockwire to lockwire screws.*

g. Install two adapter nuts in box as follows:

(1) Thread adapter nuts into control box approximately two threads.

(2) Apply sealing compound to remaining exposed threads.

(3) *Torque adapter nuts 15 to 20 inch–pounds and lockwire.*

h. *Connect aft conduit and fittings to control box and torque conduit fitting 40 to 60 inch–pounds.*

i. *Tighten bolts in conduit body connectors just aft of control box.*

j. *Install telescopic unit inner sliders, torque swivel nuts 15 to 20 inch–pounds, and lockwire.*

k. Install teleflex cables, refer to paragraph 4–75.

l. Install cooling duct below control box. Refer to T.O.1F-4C-2-7.

m. Install wire bundle support; assure four end screws engage and plates mounted on structure.

n. Install Aero 7A launcher. Refer to T.O.1F-4C-2-18.

o. Install radio receiver–transmitter. Refer to T.O.1F-4C-2-14.

p. Install autopilot amplifier and then install cover panel. Refer to T.O.1F-4C-2-16.

4–74. *Quality Assurance Summary.*

a. *Teleflex cables properly adjusted and system friction check performed.*

b. *Airframe power plant control system properly rigged to engine.*

c. *Perform engine checkout. Refer to section II.*

4–75. **TELEFLEX CABLE.**

4–76. **Removal.** See figure 4–11.

4–77. **Installation.** See figure 4–11.

4–78. **Adjustment.** Cable adjustment is accomplished during installation.

1 PREPARATION

TOOLS AND EQUIPMENT

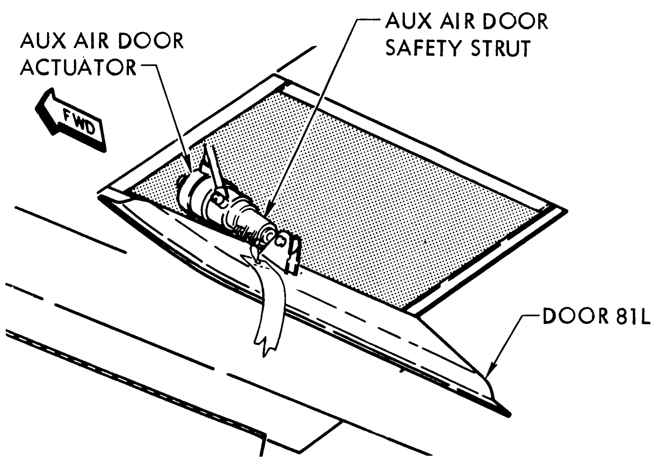
SAFETY STRUT, AUXILIARY AIR DOOR .32E050034-1

MANPOWER REQUIREMENTS

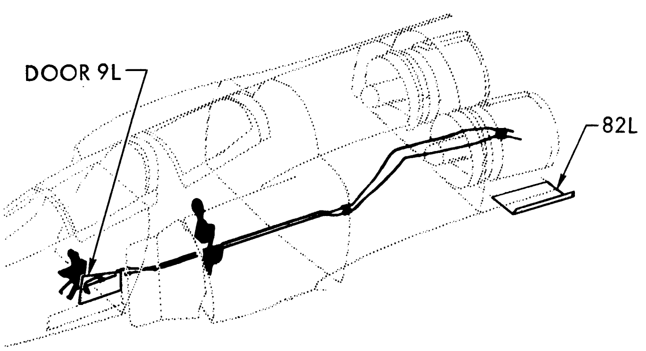
TWO MEN REQUIRED

MATERIALS

GREASE MIL-G-23827



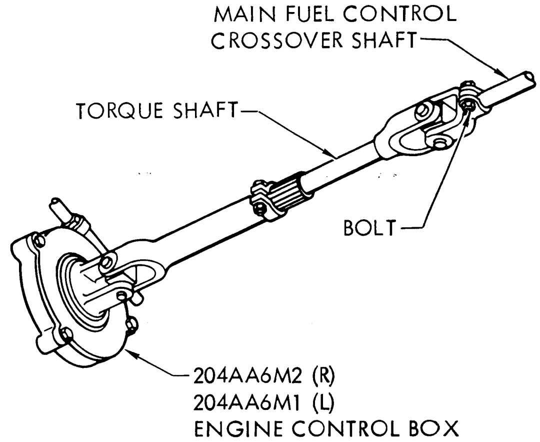
A ASSURE SAFETY STRUT IS INSTALLED ON DOOR 81L OR R ACTUATOR.



B REMOVE DOOR 9L.

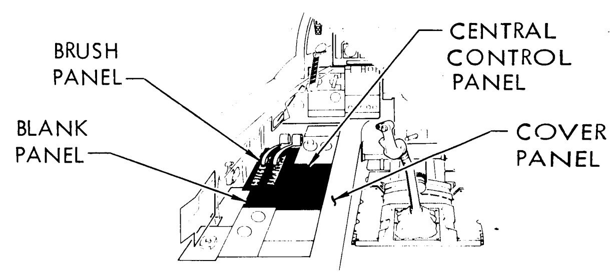
C OPEN DOOR 82L OR R.

MAJOR CHANGE



D PLACE FORWARD COCKPIT THROTTLE LEVERS IN MIL POSITION.

E REMOVE BOLT AND DISCONNECT TORQUE SHAFT FROM MAIN FUEL CONTROL (MFC) CROSSOVER SHAFT.



2 AFT COCKPIT PREPARATION

A REMOVE BRUSH PANEL BETWEEN THROTTLE LEVERS.

B REMOVE SMALL BLANK PANEL (53-81045) LOCATED AT REAR OF THROTTLE LEVERS.

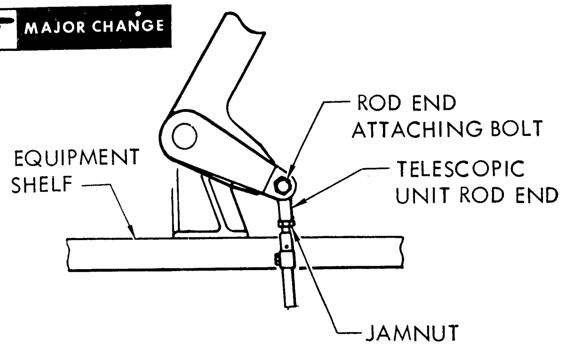
C REMOVE COVER PANEL FROM INSIDE OF LEFT CONSOLE.

D REMOVE CENTRAL CONTROL PANEL, REFER TO T.O. 1F-4C-2-14.

4C–2–8–(152–1)C

Figure 4–11. Teleflex Cable Removal and Installation (Sheet 1 of 7)

MAJOR CHANGE



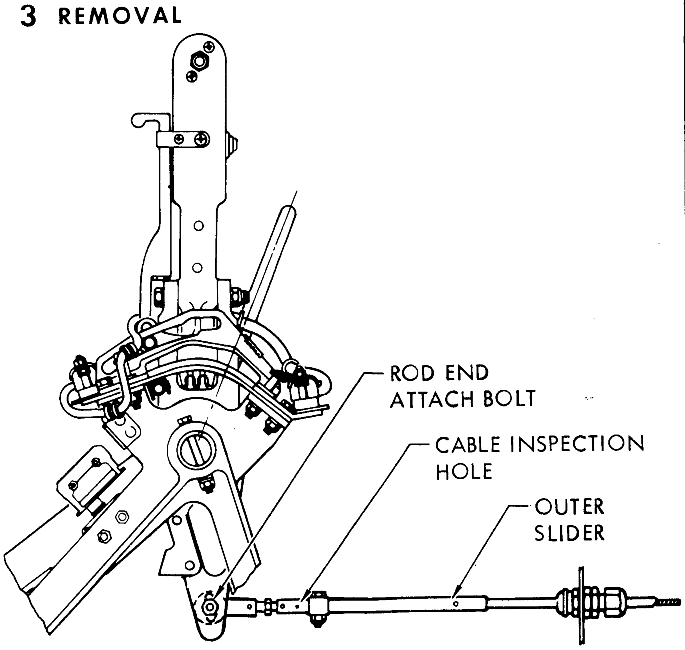
E DISCONNECT TELESCOPIC UNIT ROD END FROM THROTTLE QUADRANT.

CAUTION

MINIMUM BEND RADIUS OF TELEFLEX CABLE IS 7 INCHES. EXERCISE CARE NOT TO BEND MORE THAN THIS DURING REMOVAL, CLEANING, INSPECTION AND INSTALLATION.

F TURNING CLOCKWISE, THREAD TELESCOPIC UNIT AND CABLE ASSEMBLY OUT OF CONTROL BOX AND REMOVE CABLE FROM AIRCRAFT.

3 REMOVAL



A REMOVE FORWARD COCKPIT TELESCOPIC UNIT ROD END-TO-QUADRANT ATTACH BOLT.

CAUTION

DO NOT KINK OR DAMAGE CABLE DURING REMOVAL.

B PULL TELESCOPIC UNIT OUTER SLIDER AND CABLE ASSEMBLY FORWARD AND OUT THROUGH DOOR 9L. IDENTIFY LEFT AND RIGHT CABLES FOR REINSTALLATION.

4 INSPECTION

A CLEAN TELEFLEX CABLE, REFER TO CLEANING, DRAINING AND LUBRICATION.

NOTE

USE A MAGNIFYING GLASS TO INSPECT SMALL WIRES.

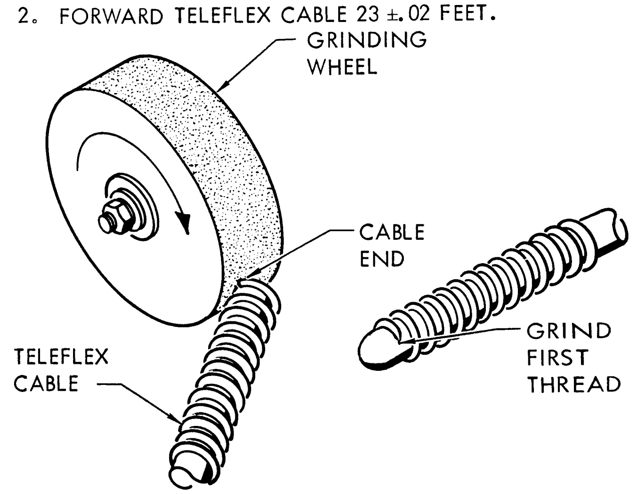
B VISUALLY INSPECT CABLE FOR WORN OR BROKEN WIRES. NOTE PARTICULARLY THE CONDITION OF SMALL DIAMETER WIRES BETWEEN LARGE WIRE HELIXES. MEASURE OUTSIDE DIAMETER OF HELIX WIRE SEVERAL PLACES WITHIN 12 INCHES OF EACH END. REPLACE CABLES WHICH MEASURE LESS THAN 0.184 INCH.

C INSPECT SMALL WIRES FOR MISWINDING SUCH AS OVERLAPPED OR CROSSED WIRES.

1. REPLACE CABLES WHICH ARE KINKED OR FRAYED.
2. REPLACE CABLES ON WHICH THE HELIX WIRE PITCH VARIES NOTICEABLY.
3. REPLACE CABLES WITH NICKS OR CUTS DEEPER THAN 0.008 INCH IN THE HELIX WIRE.

D REPLACE DEFECTIVE CABLE WITH NEW TELEFLEX CABLE, CUT NEW CABLE TO SAME LENGTH AS OLD. HOWEVER, IF NOT AVAILABLE, START WITH FOLLOWING DIMENSIONS AND TRIM TO REQUIRED LENGTH PER STEP 6M OR 8C(1).

1. AFT TELEFLEX CABLE 23 ±.25 INCHES.
2. FORWARD TELEFLEX CABLE 23 ±.02 FEET.



NOTE

CABLE UNRAVEL CAN BE PREVENTED BY CUTTING CABLE TO DESIRED LENGTH WITH GRINDING WHEEL, AT SAME TIME END IS BEING CHAMFERED.

E CHAMFER BOTH CABLE ENDS IN DIRECTION OF ROTATION OF CABLE WINDING. GRINDING WHEEL MAY BE USED AS LONG AS A SMOOTH SURFACE IS OBTAINED.

4C-2-8-(152-2)C

Figure 4-11. Teleflex Cable Removal and Installation (Sheet 2 of 7)

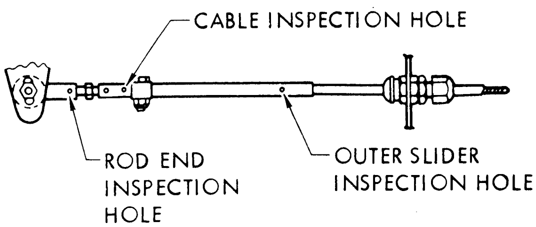
5 LUBRICATION

A LUBRICATE CABLE WITH A LIGHT COAT OF GREASE MIL-G-23827. EXERCISE CARE TO ASSURE CABLE REMAINS CLEAN.

B LUBRICATE TELESCOPIC UNITS WITH MIL-G-23827.

C LUBRICATE TELESCOPIC UNITS ROD ENDS WITH MIL-G-23827.

6 INSTALLATION OF FORWARD COCKPIT TELEFLEX CABLE

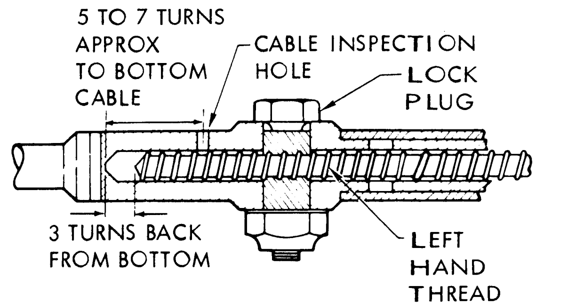


NOTE

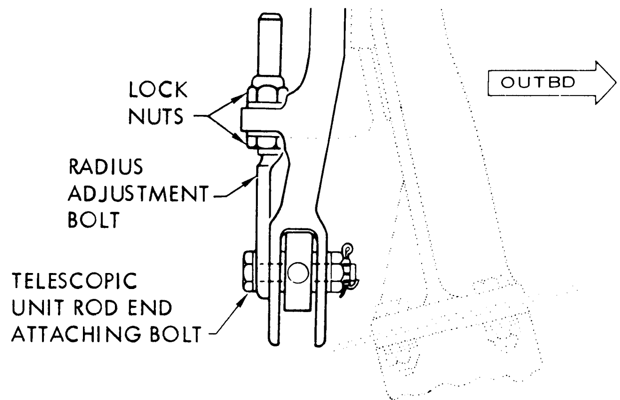
ASSURE BOTH CABLE ENDS ARE CHAMFERED IN DIRECTION OF ROTATION OF HELIX WINDING.

A TURNING COUNTERCLOCKWISE, INSTALL TELESCOPIC UNIT OUTER SLIDER TO CABLE. THREAD OUTER SLIDER ON CABLE UNTIL CABLE BOTTOMS OUT IN OUTER SLIDER.

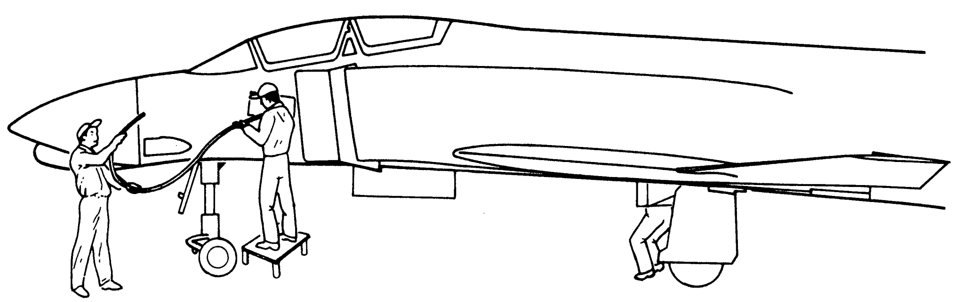
B BACK OFF THREE TURNS AND TIGHTEN LOCK PLUG. ASSURE CABLE IS VISIBLE IN CABLE INSPECTION HOLE.



C INSTALL JAMNUT AND ROD END ON OUTER SLIDER. THREAD ROD END AND JAMNUT ON UNTIL APPROXIMATELY THREE THREADS REMAIN EXPOSED. DO NOT TIGHTEN JAMNUT.



D POSITION RADIUS ADJUSTMENT BOLTS SO ROD END ATTACHING BOLT HOLES ARE MID POSITION OF SLOTS IN THROTTLE LEVERS. OTHERWISE DO NOT MOVE RADIUS ADJUSTMENT BOLT EXCEPT TO ALIGN THROTTLE LEVERS WHEN RIGGING SYSTEM TO ENGINE.



NOTE

KEEP CABLE FREE OF DIRT AND KINKS.

WIPE EXCESS GREASE OFF INNER SLIDER.

E INSERT CABLE INTO TELESCOPIC UNIT INNER SLIDER AND CONDUIT THRU DOOR 9L. HOLD ENGINE CONTROL BOX TORQUE SHAFT IN HORIZONTAL POSITION.

MAJOR CHANGE

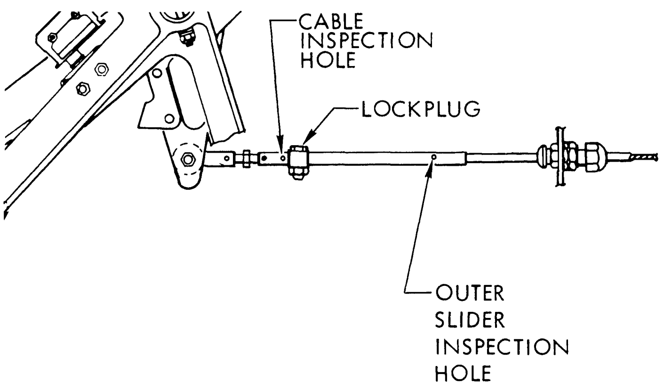
4C-2-8-(152-3)C

Figure 4-11. Teleflex Cable Removal and Installation (Sheet 3 of 7)

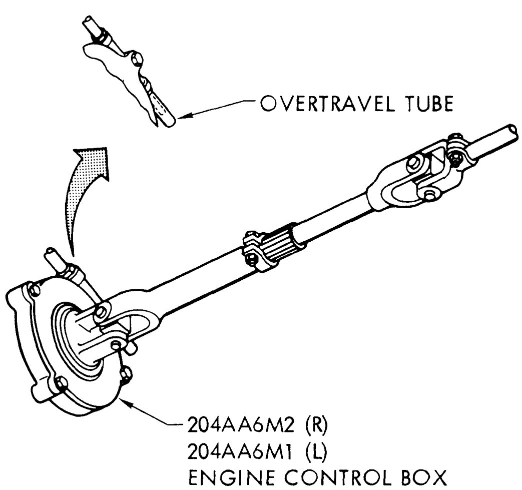
NOTE

INSTALL BOTH BOLT HEADS TO FACE CENTER OF THROTTLE QUADRANT.

F ATTACH TELESCOPIC UNIT ROD END TO THROTTLE LEVER WITH GREASE FITTING POSITIONED UP. BOTH HEADS MUST FACE CENTER OF QUADRANT. TORQUE BOLT 30 TO 40 INCH-POUNDS AND INSTALL COTTER PIN.



G POSITION FORWARD COCKPIT THROTTLE LEVER TO OFF. ASSURE TELESCOPIC UNIT INNER SLIDER DOES NOT PASS INSPECTION HOLE OF OUTER SLIDER.



H WITH THROTTLE LEVER IN OFF POSITION, REMOVE OVERTRAVEL TUBE FROM CONTROL BOX.

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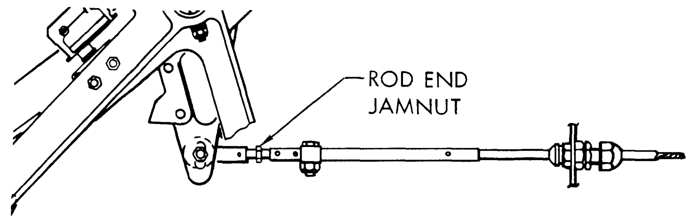
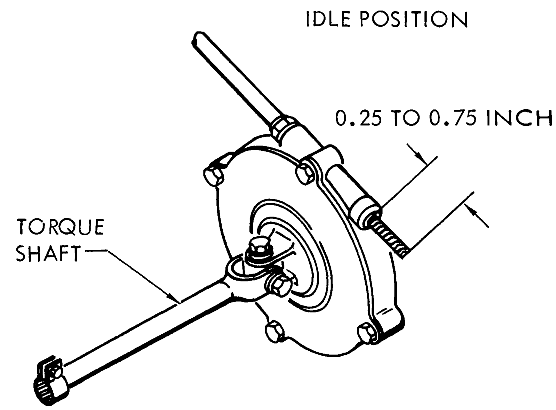


J TIGHTEN ROD END JAMNUT.

K WHEN CONDITION SPECIFIED IN STEP G IS NOT MET, DISCONNECT TELESCOPIC UNIT ROD END FROM QUADRANT AND TURN ROD END TO PROPERLY POSITION OUTER SLIDER. ASSURE THREADS ARE VISIBLE THROUGH ROD END INSPECTION HOLE AND THEN ATTACH ROD END TO QUADRANT.

L POSITION FORWARD COCKPIT THROTTLE LEVER IN IDLE.



ENGINE CONTROL BOX

M MEASURE CABLE EXTENDING BEYOND CONTROL BOX OUTLET. CABLE MUST EXTEND 0.25 TO 0.75 INCH OUT OF ENGINE CONTROL BOX. IF CABLE IS TOO SHORT, REPLACE CABLE, IF CABLE IS TOO LONG, UTILIZE FOLLOWING PROCEDURE:

1. MARK CABLE TO DESIRED LENGTH.

CAUTION

DO NOT CUT TELEFLEX CABLE WHILE INSTALLED IN AIRCRAFT. CABLE END MAY UNRAVEL IN ENGINE CONTROL BOX AND CAUSE CONTROL BOX DAMAGE.

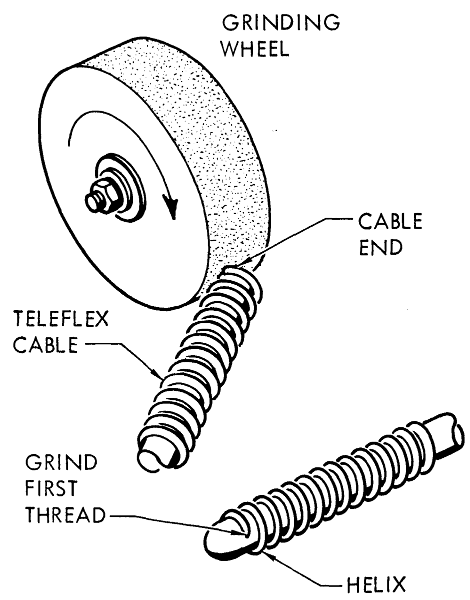
NOTE

CABLE UNRAVEL CAN BE PREVENTED BY CUTTING CABLE TO DESIRED LENGTH WITH GRINDING WHEEL, AT SAME TIME END IS BEING CHAMFERED.

2. REMOVE CABLE FROM AIRCRAFT AND CUT TO PROPER LENGTH.

4C–2–8–(152–4)C

Figure 4-11. Teleflex Cable Removal and Installation (Sheet 4 of 7)



3. CHAMFER CABLE END IN DIRECTION OF ROTATION OF HELIX WINDING. A GRINDING WHEEL MAY BE USED AS LONG AS SMOOTH SURFACE IS OBTAINED.

4. INSPECT CABLE END FOR UNRAVELING. DISCARD CABLE IF UNRAVELING EXISTS.

5. INSERT CABLE INTO TELESCOPIC UNIT INNER SLIDER AND CONDUIT THRU DOOR 9L. HOLD ENGINE CONTROL BOX TORQUE SHAFT IN HORIZONTAL POSITION.

6. ATTACH TELESCOPIC UNIT ROD END TO THROTTLE LEVER WITH GREASE FITTING POSITIONED UP. BOLT HEADS MUST FACE CENTER OF QUADRANT.

7. TORQUE BOLT 30 TO 40 INCH-POUNDS AND INSTALL COTTER PIN.

8. POSITION FORWARD COCKPIT THROTTLE LEVER TO OFF. ASSURE TELESCOPIC UNIT INNER SLIDER DOES NOT PASS INSPECTION HOLE OF OUTER SLIDER.

9. ASSURE THREADS ARE VISIBLE THROUGH ROD END INSPECTION HOLE AND THEN ATTACH ROD END TO QUADRANT.

10. POSITION FORWARD COCKPIT THROTTLE LEVER IN IDLE.

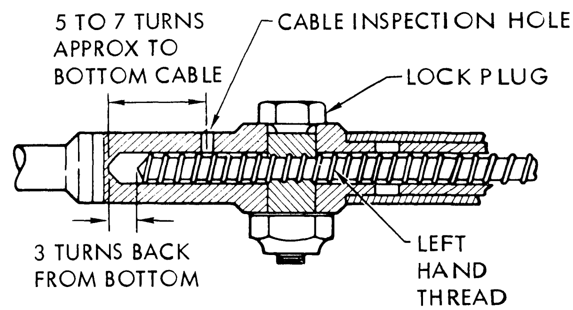
11. ASSURE CABLE EXTENDS 0.25 TO 0.75 INCH BEYOND ENGINE CONTROL BOX OUTLET.

N RIG FORWARD COCKPIT THROTTLE SYSTEM BEFORE INSTALLING AFT COCKPIT TELEFLEX CABLES.

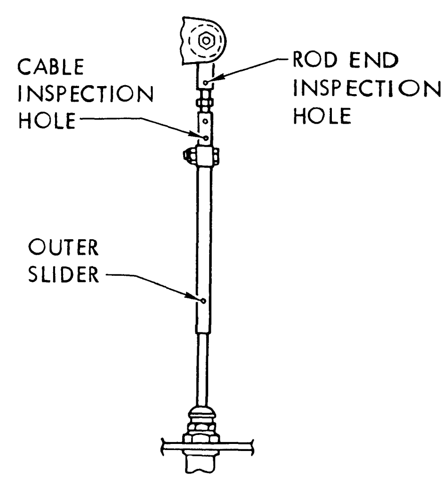
7 INSTALLATION OF AFT COCKPIT TELEFLEX CABLE

A REMOVE MISSILE LAUNCHER FROM LEFT FORWARD MISSILE CAVITY. REFER TO T.O. 1F-4C-2-18. REMOVE AFT COCKPIT CONTROL BOX OVERTRAVEL TUBE.

B POSITION FORWARD COCKPIT THROTTLE LEVER AT OFF.



C INSTALL TELESCOPIC UNIT OUTER SLIDER ON TELEFLEX CABLE. THREAD OUTER SLIDER ON CABLE UNTIL CABLE BOTTOMS OUT AND THEN BACK OFF APPROXIMATELY THREE TURNS. TIGHTEN LOCK PLUG.

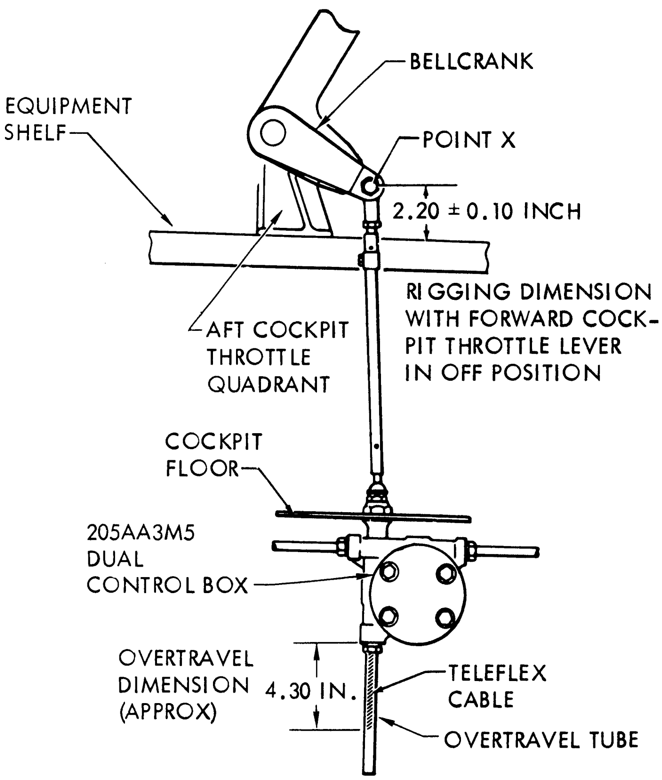


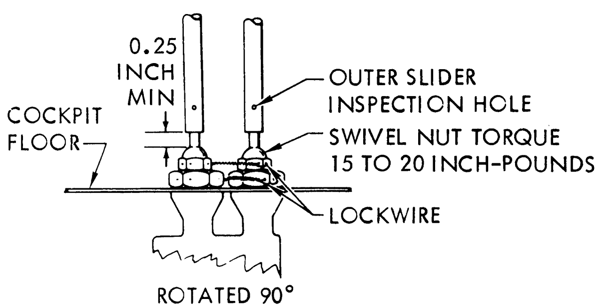
D INSTALL ROD END JAMNUT ON OUTER SLIDER. THREAD ROD END ON OUTER SLIDER UNTIL APPROXIMATELY THREE THREADS REMAIN EXPOSED. DO NOT TIGHTEN JAMNUT.

MAJOR CHANGE

4C-2-8-(152-5)C

Figure 4-11. Teleflex Cable Removal and Installation (Sheet 5 of 7)





NOTE

INSTALL BOTH ROD END ATTACH BOLTS WITH NUTS FACING TOWARD CENTER-LINE OF AIRCRAFT.

E INSERT CABLE INTO INNER SLIDER AND THREAD CABLE THROUGH CONTROL BOX BY ROTATING OUTER SLIDER COUNTERCLOCKWISE BEING SURE FORWARD COCKPIT THROTTLE LEVER REMAINS IN OFF POSITION. THREAD CABLE THROUGH CONTROL BOX UNTIL ROD END WILL CONNECT TO THROTTLE LEVER BELLCRANK WITH THROTTLE LEVER POSITIONED SO DISTANCE FROM CENTER OF ATTACHING BOLT (POINT X) TO EQUIPMENT SHELF IS 2.20 ±0.10 INCHES.

F ASSURE INNER SLIDER SWIVEL NUTS ARE TORQUED AND LOCKWIRED.

8 AFT COCKPIT THROTTLE LEVER ALIGNMENT

A POSITION FORWARD COCKPIT THROTTLE LEVER AT IDLE.

B CHECK ALIGNMENT AFT COCKPIT THROTTLE LEVERS. LEVERS MUST BE ALIGNED WITHIN 0.25 INCH AT TOP OF LEVER. ALIGN AS FOLLOWS:

1. ROTATE TELESCOPIC UNIT OUTER SLIDER AT THROTTLE BELLCRANK UNTIL ALIGNMENT IS OBTAINED.
2. TIGHTEN ROD END JAMNUT.
3. ASSURE THREADS ARE VISIBLE IN ROD END INSPECTION HOLE.
4. POSITION FORWARD COCKPIT THROTTLE LEVER AT OFF AND CHECK RIGGING DIMENSION OF POINT X TO EQUIPMENT SHELF. DIMENSION MUST BE MAINTAINED.

C WITH FORWARD COCKPIT THROTTLE LEVER AT OFF CHECK OUTER SLIDER TO-SWIVEL NUT FOR MINIMUM CLEARANCE OF 0.25 INCH. USE OF AUTHORIZED SPECIAL TOOL IS OPTIONAL FOR CLEARANCE CHECK.

1. ALSO CHECK THAT TELEFLEX CABLE EXTENDS APPROXIMATELY 4.30 INCHES BEYOND AFT COCKPIT CONTROL BOX.

D POSITION FORWARD COCKPIT THROTTLE LEVER IN MAX AB POSITION AND CHECK:

1. THAT AFT COCKPIT TELESCOPIC UNIT INNER SLIDER DOES NOT PASS INSPECTION HOLE IN OUTER SLIDER.
2. WHEN CONDITIONS SPECIFIED IN STEPS C AND D ARE NOT MET, ADJUST OUTER SLIDER AND ROD END TO PROPERLY POSITION OUTER SLIDER AND AT THE SAME TIME MAINTAIN RIGGING DIMENSION WITHIN LIMITS.
3. TIGHTEN ROD END JAMNUT AND CABLE LOCK PLUG.
4. INSTALL COTTER PINS IN ROD END ATTACH BOLTS.

E INSTALL OVERTRAVEL TUBE ON AFT COCKPIT CONTROL BOX AND ENGINE CONTROL BOX. TORQUE OVERTRAVEL TUBES 40 TO 60 INCH POUNDS AND LOCKWIRE.

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4C-2-8-(152-6)C

Figure 4-11. Teleflex Cable Removal and Installation (Sheet 6 of 7)

9 CHECKOUT AND DOOR INSTALLATION

A PERFORM A POWER PLANT CONTROL SYSTEM FRICTION CHECK.

B PERFORM AIRFRAME POWER PLANT CONTROL SYSTEM RIGGING CHECK

NOTE

ASSURE THE TWO DRAIN HOLES IN BOTTOM OF ENGINE CONTROL BOX ARE OPEN.

C PERFORM FOLLOWING STEPS AFTER COMPLETION OF QUALITY ASSURANCE CHECK.

1. INSTALL CENTRAL CONTROL PANEL. REFER TO T.O. 1F-4C-2-14.
2. INSTALL AFT COCKPIT BRUSH PANEL AND COVER PANELS.
3. INSTALL DOOR 9L.
4. INSTALL LEFT FORWARD MISSILE LAUNCHER. REFER TO T.O. 1F-4C-2-18.

MAJOR CHANGE

5. PERFORM ENGINE OPERATION PER TABLE OF POST INSTALLATION INITIAL ENGINE RUN-UP CHECKS.

10 QUALITY ASSURANCE SUMMARY

A TELEFLEX CABLE AND TELESCOPIC UNITS PROPERLY ADJUSTED.

B ROD END JAMNUTS TIGHTENED.

C CABLE LOCK PLUGS TIGHTENED.

D THREADS VISIBLE IN ALL ROD END INSPECTION HOLES.

E CABLE VISIBLE IN TELESCOPIC UNIT CABLE INSPECTION HOLE.

F FRICTION CHECK PERFORMED.

G COTTER PINS INSTALLED IN ROD END ATTACHING BOLTS.

H ENGINE RUN PERFORMED.

4C–2–8–(152–7)C

Figure 4-11. Teleflex Cable Removal and Installation (Sheet 7 of 7)

4-79. **ENGINE MANIFOLD SHUTOFF VALVE.** Data for the engine fuel manifold shutoff valve is contained in T.O.1F-4C-2-10.

4-80. **THROTTLE CUTOFF SWITCH.**

4-81. **Tools and Equipment.**

Multimeter, AN/PSM-6( )

4-82. **Removal.**

a. Remove door 9L.

b. If outboard engine control panel wire bundle is in the way, disconnect outboard engine control panel bundle plug and position it to one side.

c. Assure engine master switches are OFF and position forward cockpit throttle levers in MAX AB.

d. Disconnect wires from switch.

e. Remove switch actuator locknut and adjustment nut from bottom side of mounting bracket. Remove switch and actuator from mounting bracket as a unit.

f. Remove switch to actuator mounting bolts and remove switch from actuator.

4-83. **Installation and Adjustment.**

NOTE

Check cutoff switch actuator for freedom of movement. Replace if faulty.

a. Install switch to actuator.

b. Install switch and actuator in mounting bracket and install adjustment nut loosely.

c. With airframe power plant control system properly rigged to engine, position forward cockpit throttle lever and main fuel control OFF (main fuel control OFF position cam notch aligned with rig pin port or vernier reference marks align).

d. *Turn adjustment nuts down on actuator until normally open contacts show continuity. Turn adjustment nuts down an additional 0.08 $\pm$0.03 (approximately 2 1/2 threads) inches to give switch necessary overtravel.*

e. Tighten adjustment nuts and locknuts.

f. *Attach wires to switch, see figure 4-7 for wire connections.*

g. *Position throttle lever full aft and assure switch actuator does not bottom out.*

h. Perform an engine manifold shutoff valve operational check, refer to T.O.1F-4C-2-10.

i. Connect outboard engine control panel bundle plug.

j. Install door 9L.

4-84. *Quality Assurance Summary.*

a. *Door 9L installed.*

4-85. **BASIC ENGINE CONTROL REPLACEMENT AND RIGGING PROCEDURES.** Rigging control linkage system consists basically of:

a. Disengaging control shafts from linkage.

b. Externally locking shafts at their designed rig point.

c. Positioning linkage to correspond to engine operating condition at which control shafts are locked.

d. Engaging linkage with control shafts.

e. Unlocking control shafts.

4-86. **Rigging Precautions.** Following precautions should be followed when performing maintenance on control linkage system:

a. Flexible cables must not be kinked or nicked. Any exterior damage to cable may cause an engine malfunction.

b. Flexible cables must not be made into a roll less than 10 inches in diameter.

c. Lubricate flexible cables.

d. Various sizes of flexible cable are available. When replacing a cable be certain replacement cable is proper diameter and length.

e. Variable vane feedback linkage and variable nozzle feedback linkage are spring loaded. Be careful not to allow spring tension to be released suddenly. If snapback should occur despite all precautions, check for damage as follows:

(1) Variable vane feedback linkage - Remove cable box from main fuel control and check stops (which can be seen with cable box removed) on control are not cracked or distorted. Check that rotation of feedback shaft is smooth and that shaft does not bind. Reinstall cable box and rig linkage. Check during operation of engine that performance is satisfactory.

(2) Nozzle feedback linkage. Check that diameter of nozzle, when rig pin can be inserted easily into port of nozzle area control, is 22 5/16 $\pm$ 1/16 inches. Check cable for freedom and for correct positioning. Check during engine test that nozzle operation is normal.

f. Rotate control shaft slightly back and forth when tightening cable box shaft nuts, to assure proper engagement of toothed clutches.

g. Replace tab washers on which tabs have been previously bent.

h. Do not torque sheave cover screws unless cable properly engages sheave.

i. Assure all conduit nuts, cable box bolts, and sheave cover bolts are lockwired after final rigging.

j. If excessive force is required to turn a microadjustment unit, disassemble unit and coat male threads with lubricant (MIL-L-23398). Reassemble and install unit.

4-87. VARIABLE VANE FEEDBACK LINKAGE.

4-88. Tools and Equipment.

Pressurizing unit, variable vane
Set, rigging

4-89. Materials.

Lockwire, MS20995NC32

4-90. Manpower Requirements.

a. Two men required.

4-91. Removal.

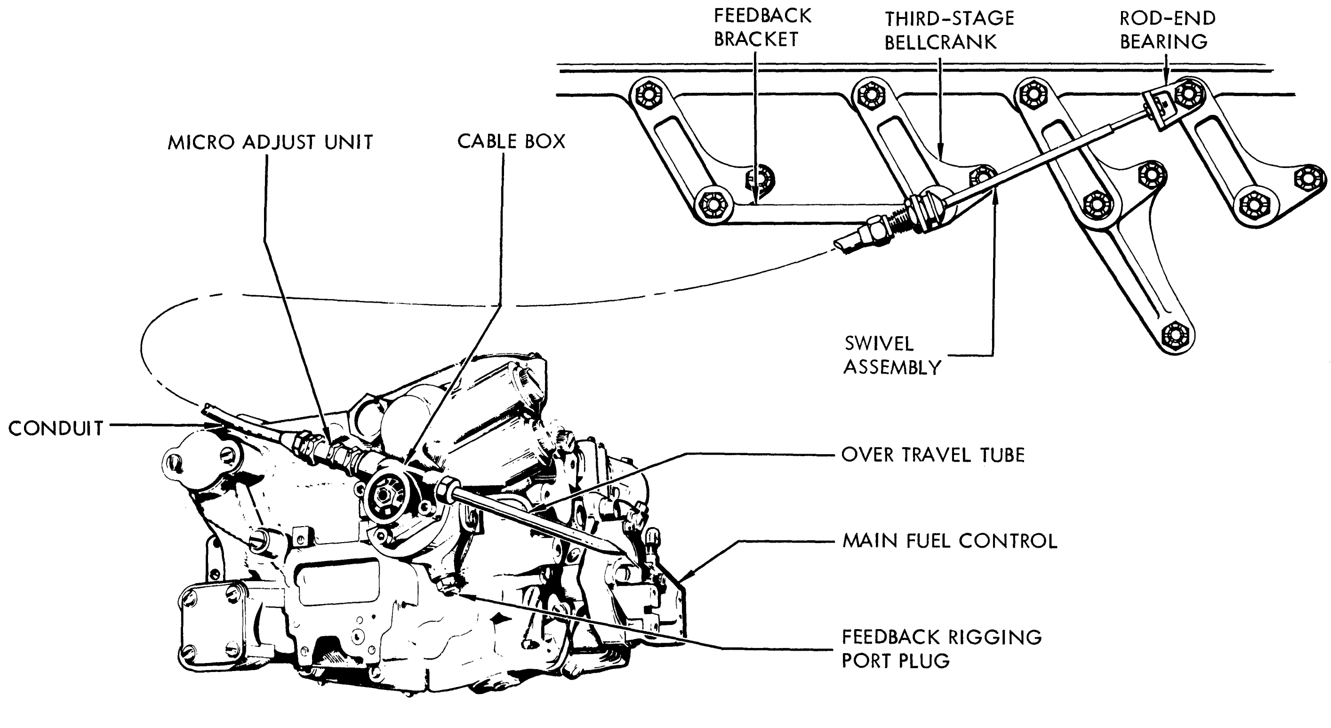
a. Open door 82 L or R and disconnect actuator from door 81 L or R.

b. See figure 4-12 for remainder of procedures.

4-92. Installation. See figure 4-12.

4-93. Rigging. See figure 4-12.

a. Close door 82 L or R and connect door 81 L or R actuator.



REMOVAL

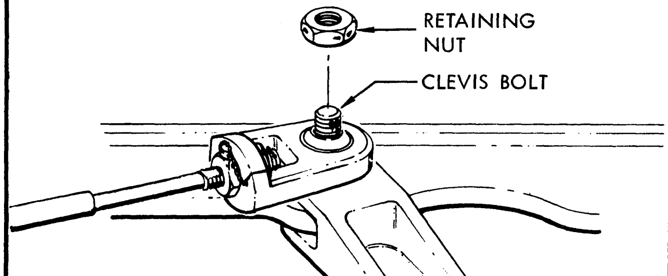
1 CABLE RELEASE

CAUTION

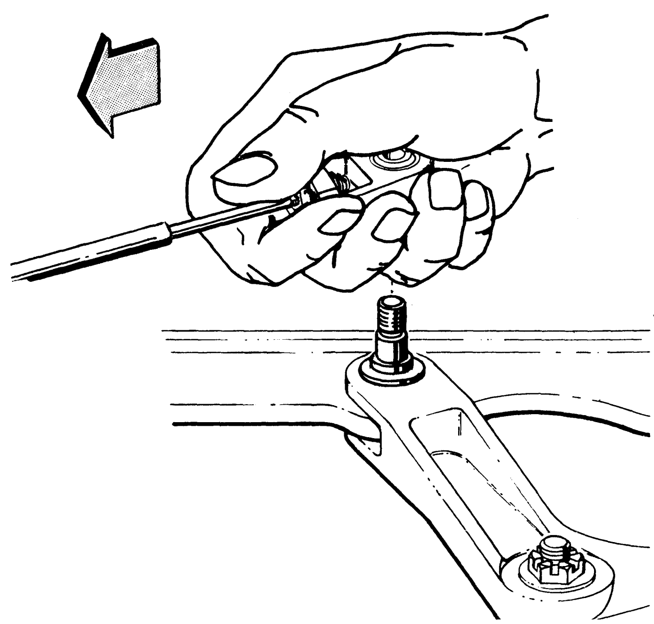
GAIN ACCESS TO THE FIRST STAGE BELLCRANK CLEVIS BOLT THROUGH THE BYPASS BELLMOUTH. TAKE PRECAUTIONS TO BE SURE HARDWARE ITEMS/TOOLS DO NOT CAUSE FOD TO THE ENGINE COMPRESSOR.

THE VARIABLE VANE FEEDBACK CABLE IS SPRING-LOADED IN THE MAIN FUEL CONTROL. DO NOT LET THE CABLE RETRACT SUDDENLY. THIS MAY DAMAGE THE MAIN FUEL CONTROL STOPS.

a REMOVE THE ROD-END BEARING RETAINING NUT FROM THE FIRST-STAGE BELLCRANK CLEVIS BOLT.



b HOLD THE ROD-END BEARING FIRMLY, SEPARATE THE ROD-END BEARING FROM THE CLEVIS BOLT, AND ALLOW THE SPRING TENSION TO RETRACT THE CABLE SLOWLY, AGAINST THE MAIN FUEL CONTROL STOP.



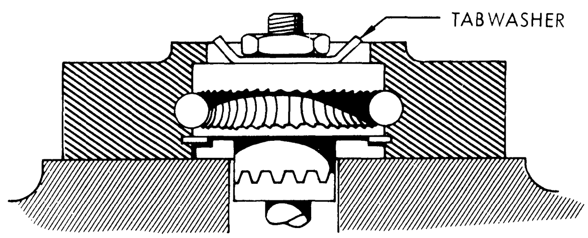
c REPLACE THE NUT ON THE CLEVIS BOLT AND TIGHTEN FINGERTIGHT.

4C-2-8-(31-1)B

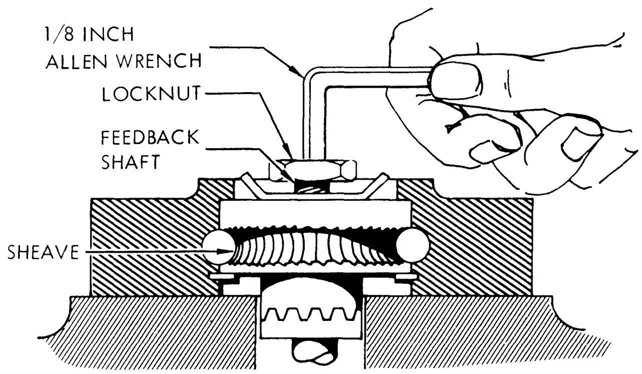
Figure 4-12. Variable Vane Feedback Linkage (Sheet 1 of 10)

2 **CLUTCH DISENGAGEMENT**

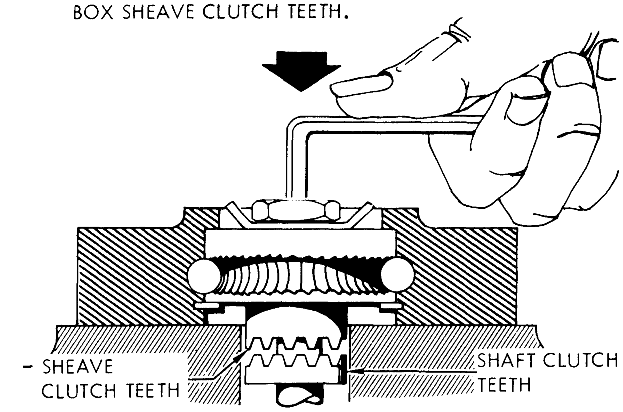
a STRAIGHTEN THE BENT TAB ON THE TABWASHER UNDER THE FEEDBACK SHAFT LOCKNUT.



b HOLD THE FEEDBACK SHAFT WITH AN ALLEN WRENCH AND LOOSEN THE SHAFT LOCKNUT AT LEAST 1-1/2 TURNS.

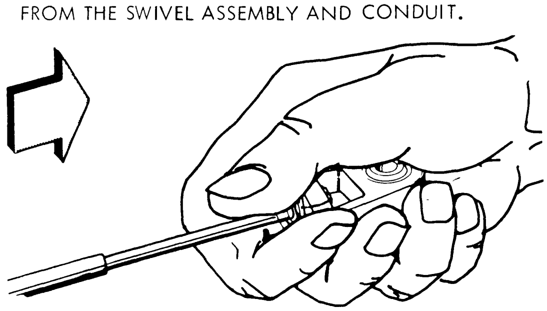


c PUSH THE SHAFT INWARD WITH THE ALLEN WRENCH TO DISENGAGE THE SHAFT CLUTCH TEETH FROM THE CABLE BOX SHEAVE CLUTCH TEETH.

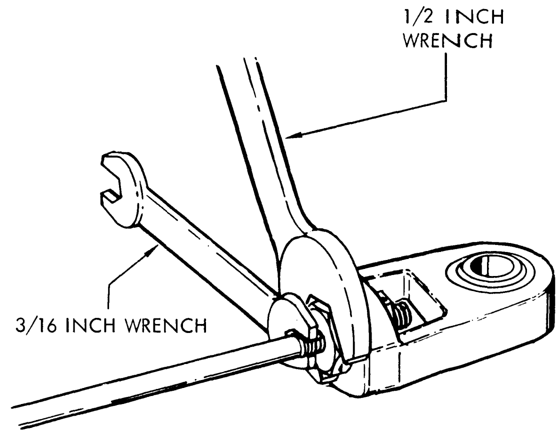


3 **CABLE REMOVAL**

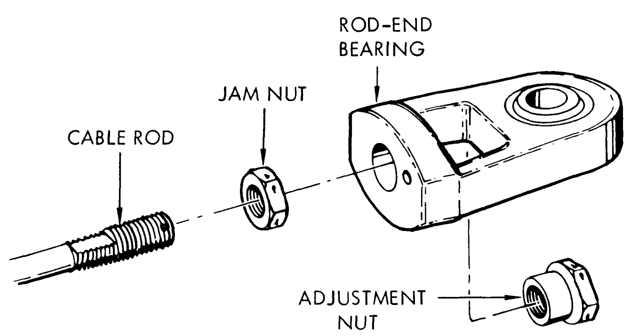
a HOLD THE ROD-END BEARING AND PULL THE CABLE FROM THE SWIVEL ASSEMBLY AND CONDUIT.



b HOLD THE FLAT ON THE CABLE ROD WITH A 3/16 INCH WRENCH AND USE A 1/2 INCH WRENCH TO LOOSEN THE JAM NUT.



c REMOVE THE ADJUSTMENT NUT, ROD-END BEARING, AND JAM NUT FROM THE FEEDBACK CABLE ROD.



4 **COMPLETE DISASSEMBLY**

a DISCONNECT ANY CLAMPS FROM THE CONDUIT, THEN SEPARATE THE CONDUIT FROM THE MICRO-ADJUST UNIT AND THE SWIVEL ASSEMBLY.

J79-B3354-3-A2

4C-2-8-(31-2)

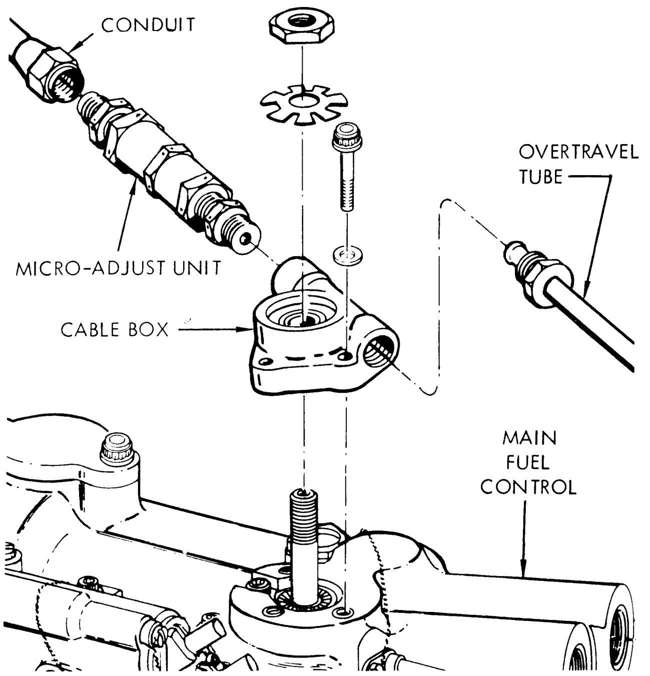
Figure 4-12. Variable Vane Feedback Linkage (Sheet 2 of 10)

4

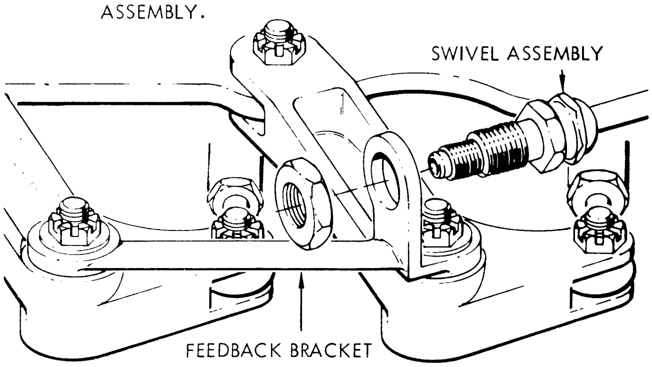
NOTE

IN THE FOLLOWING STEP, IF THE CABLE BOX IS DIFFICULT TO REMOVE DO NOT USE FORCE (WHICH MAY CAUSE INTERNAL DAMAGE TO THE CONTROL); RETURN THE MAIN FUEL CONTROL, WITH CABLE BOX ATTACHED, TO OVERHAUL.

b DISCONNECT THE OVERTRAVEL TUBE AND THE MICRO-ADJUST UNIT FROM THE CABLE BOX. REMOVE THE LOCKNUT, TABWASHER AND THE CABLE BOX MOUNTING BOLTS; THEN REMOVE THE CABLE BOX FROM THE MAIN FUEL CONTROL. DISCARD THE TABWASHER.



c REMOVE THE JAM NUT SECURING THE SWIVEL ASSEMBLY TO THE MOUNTING BRACKET, THEN REMOVE THE ASSEMBLY.



d REPLACE THE JAM NUT ON THE SWIVEL ASSEMBLY FINGERTIGHT.

J79-B6381-0-A2
4C-2-8-(31-3)

Figure 4-12. Variable Vane Feedback Linkage (Sheet 3 of 10)

INSTALLATION

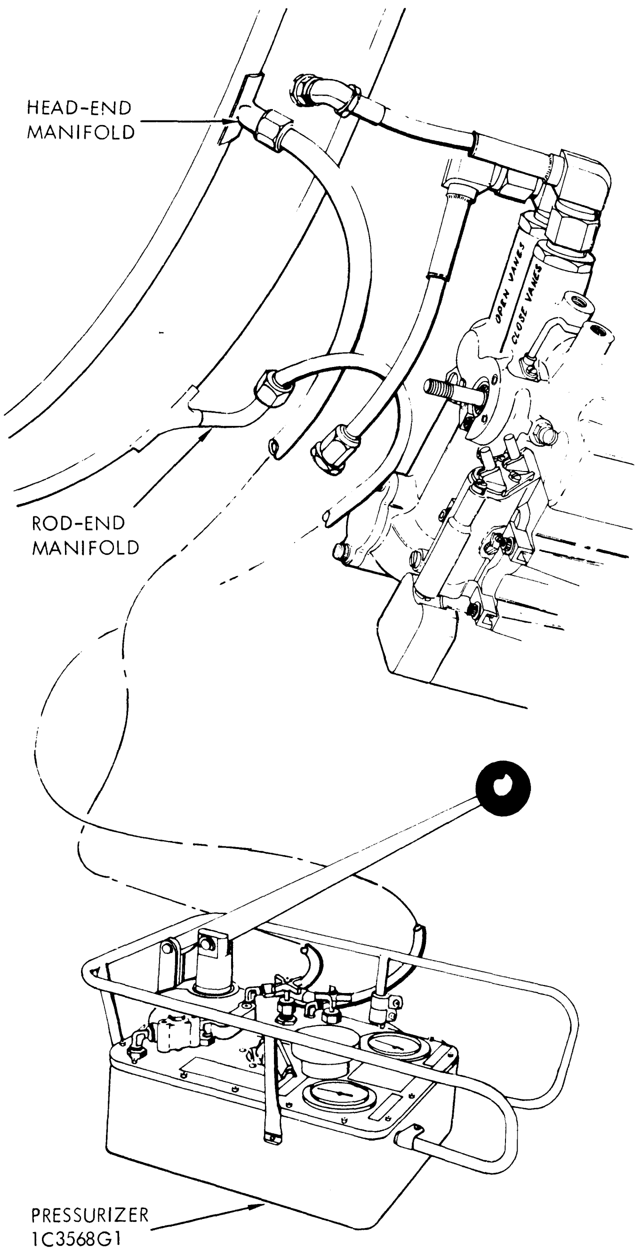
1 PRESSURIZER CONNECTION

CAUTION

USE CARE TO AVOID KINKING HOSES DURING REMOVAL AND INSTALLATION.

a DISCONNECT THE HEAD-END AND ROD-END HOSES FROM THE VARIABLE VANE ACTUATOR MANIFOLDS.

b CONNECT VANE ACTUATOR PRESSURIZER, 1C3568G1, TO THESE MANIFOLDS.

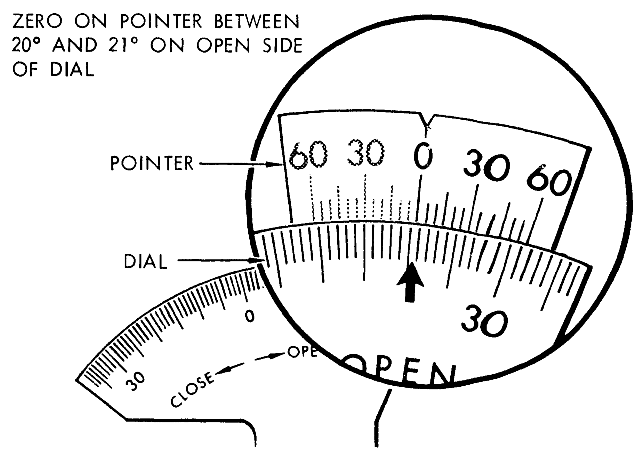


2 VANE POSITIONING

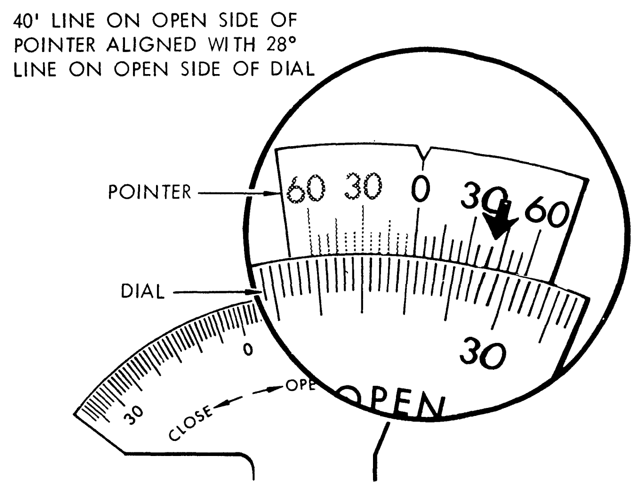
CAUTION

IN THE FOLLOWING STEP, THE VANES MUST NOT BE ACTUATED MECHANICALLY. USE OF AN EXTENSION ARM ON THE BELL-CRANK WILL EXERT UNEQUAL FORCES ON OPPOSITE SIDES OF THE ENGINE AND MAY DAMAGE THE LINKAGE.

ACTUATE THE VANES FULL OPEN AGAINST THE STOPS, THEN BACK TO 20°40' OPEN, AS READ ON THE VANE POSITION INDICATOR. DO NOT APPROACH THIS READING FROM ANY POSITION EXCEPT FULL-OPEN; IF 20° 40' IS PASSED WHILE TRYING TO SET THE VANES, GO BACK TO THE FULL-OPEN POSITION AND START AGAIN.



VPI CORRECTLY SET AT 20° 40'



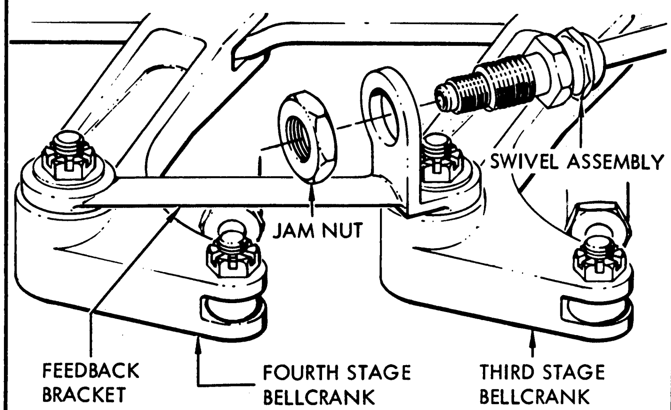
J79-B3355-1-A2A

4C-2-8-(31-4)

Figure 4-12. Variable Vane Feedback Linkage (Sheet 4 of 10)

3 SWIVEL ASSEMBLY

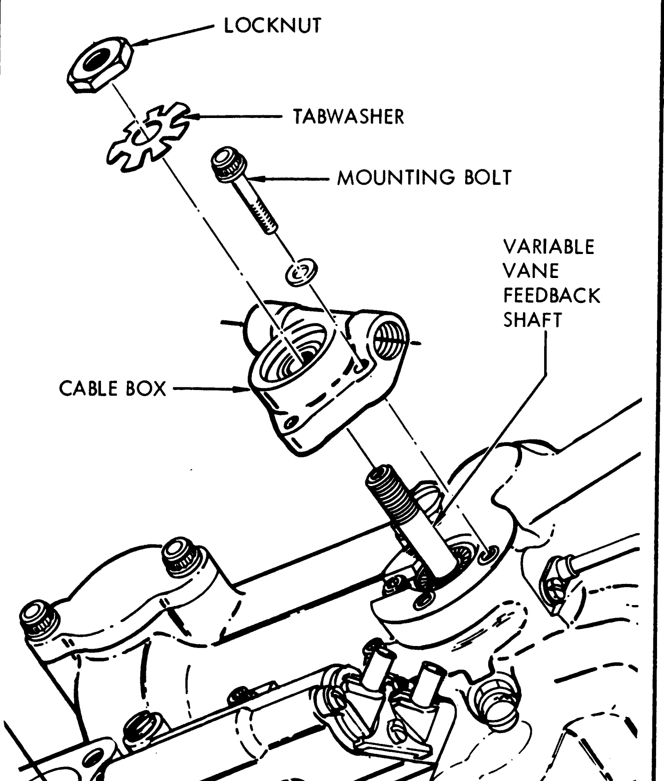
a REMOVE THE JAM NUT FROM THE SWIVEL ASSEMBLY, AND INSERT THE ASSEMBLY THROUGH THE FEEDBACK BRACKET. INSTALL THE JAM NUT; TORQUE TO 80-90 LB-IN.



4 CABLE BOX

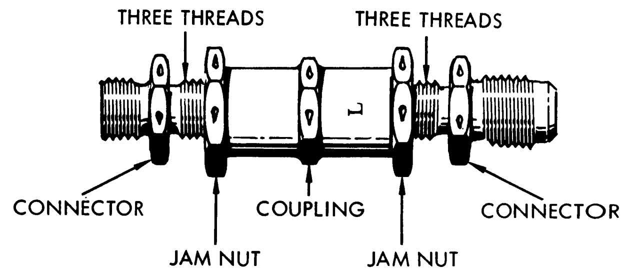
a MOUNT THE CABLE BOX TO THE MAIN FUEL CONTROL WITH THREE WASHERS AND BOLTS; TORQUE TO 24-27 LB-IN.

b INSTALL A NEW TABWASHER AND LOCKNUT ON THE FEEDBACK SHAFT. MAKE SURE THAT THE LOCKNUT IS LOOSENED AT LEAST 1-1/2 TURNS AND THAT THE SHAFT IS PUSHED INWARD SO THAT THE SHAFT AND CABLE BOX SHEAVE CLUTCH TEETH DO NOT ENGAGE.

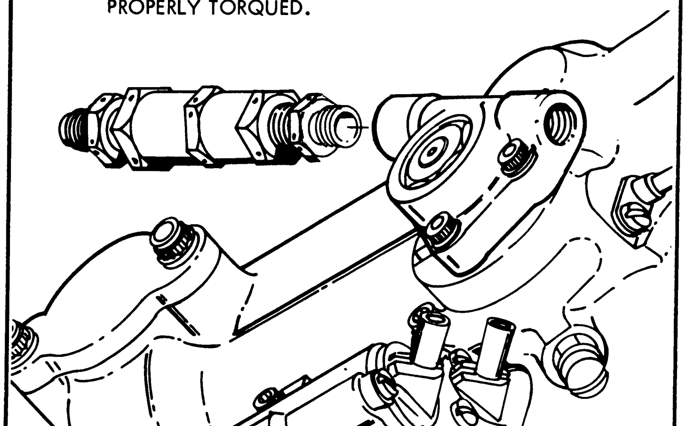


5 MICRO-ADJUST UNIT

a CENTER THE MICRO-ADJUST UNIT. WITH THE JAM NUTS RUN UP AGAINST THE MICRO-ADJUST COUPLING FINGERTIGHT, THREE THREADS MUST SHOW BETWEEN EACH JAM NUT AND THE CORRESPONDING CONNECTOR HEX.



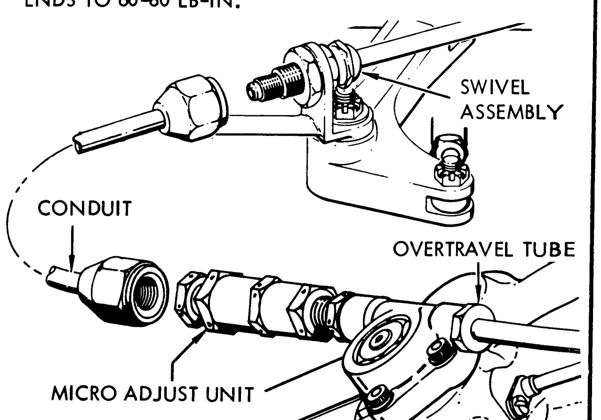
b THREAD THE MICRO-ADJUST UNIT INTO THE CABLE BOX;TORQUE THE CONNECTOR TO 50-60 LB-IN. A GAP OF 5/64 INCH MAX BETWEEN THE CONNECTOR HEX AND THE CABLE BOX IS PERMISSIBLE IF PROPERLY TORQUED.



6 CONDUIT

a INSTALL THE CONDUIT BETWEEN THE MICRO-ADJUST UNIT AND THE SWIVEL ASSEMBLY.

b TORQUE THE CONDUIT COUPLING NUTS AT BOTH ENDS TO 60-80 LB-IN.



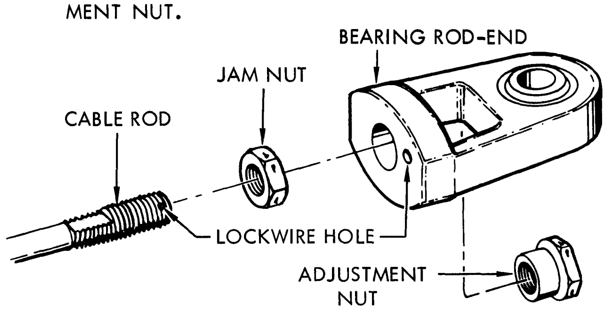
c INSTALL THE OVERTRAVEL TUBE ON THE CABLE BOX; TORQUE TO 10-20 LB-IN.

J79-B3356-0-A2
4C-2-8-(31-5)

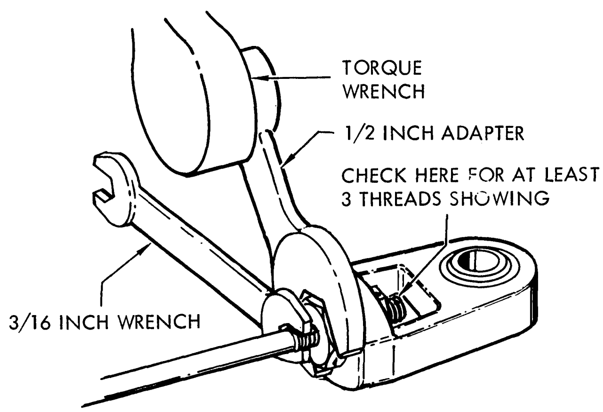
Figure 4-12. Variable Vane Feedback Linkage (Sheet 5 of 10)

7 ROD-END BEARING

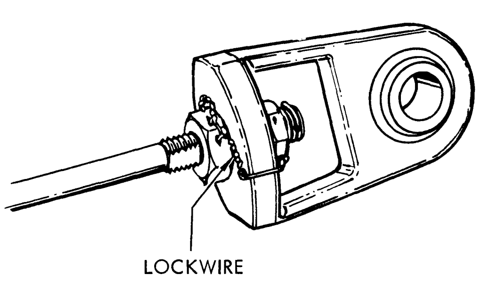
a INSERT THE ADJUSTMENT NUT INTO THE ROD-END BEARING AND THREAD THE JAM NUT, ROD-END BEARING, AND ADJUSTMENT NUT ONTO THE FEEDBACK CABLE ROD. THE BEARING SHOULD BE CENTERED ON THE CABLE ROD WITH AT LEAST THREE THREADS SHOWING BEYOND THE ADJUSTMENT NUT.



b HOLD THE FLAT ON THE CABLE ROD WITH A 3/16 INCH WRENCH AND TORQUE THE JAM NUT TO 27-35 LB-IN.

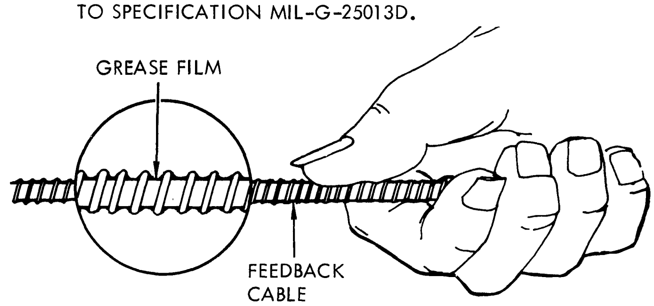


c LOCKWIRE FROM THE HOLE IN THE CABLE ROD TO THE ADJUSTMENT NUT, THROUGH THE HOLE IN THE ROD-END BEARING, AND TO THE JAM NUT.



8 CABLE INSTALLATION

a LUBRICATE THE CABLE LIGHTLY WITH SILICONE GREASE (DOW-CORNING 33, LIGHT) OR GREASE CONFORMING TO SPECIFICATION MIL-G-25013D.

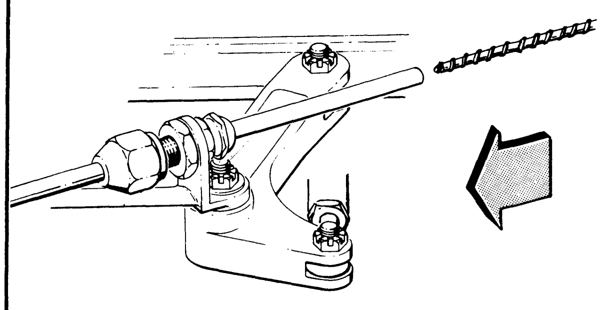


b MAKE SURE THAT THE CONTROL FEEDBACK SHAFT LOCKNUT IS LOOSENED AT LEAST 1-1/2 TURNS AND THAT THE SHAFT IS PUSHED INWARD SO THE SHAFT AND CABLE BOX SHEAVE CLUTCH TEETH DO NOT ENGAGE.

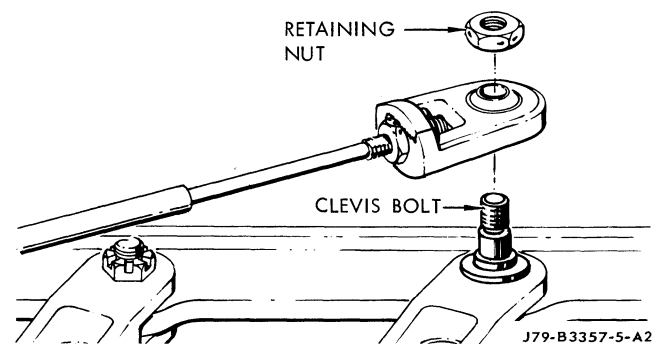
CAUTION

IN THE FOLLOWING STEP, DO NOT FORCE THE CABLE THROUGH THE SYSTEM. IF AN OBSTRUCTION EXISTS, REMEDY THE PROBLEM.

c INSERT THE CABLE INTO THE CONDUIT AT THE SWIVEL ASSEMBLY.



d ALIGN THE ROD-END BEARING WITH THE CLEVIS BOLT ON THE FIRST-STAGE BELLCRANK, CONNECT THE BEARING TO THE PIN, AND INSTALL THE RETAINING NUT FINGERTIGHT.



J79-B3357-5-A2

4C-2-8-(31-6)A

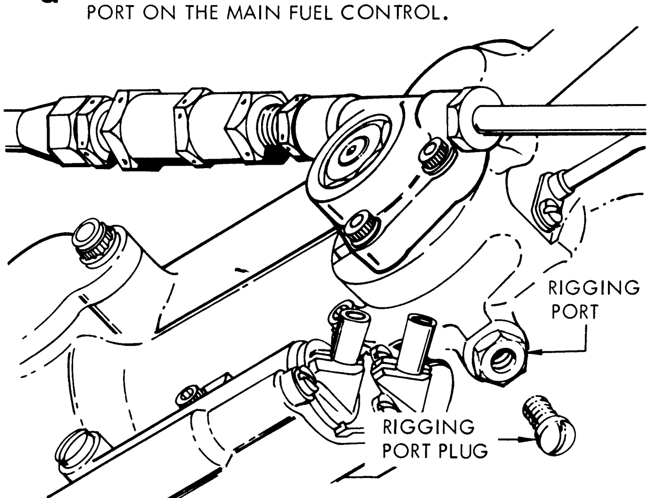
Figure 4-12. Variable Vane Feedback Linkage (Sheet 6 of 10)

9 CLUTCH ENGAGEMENT

WARNING

IN THE FOLLOWING STEP, FUEL MAY DRAIN FROM THE RIGGING PORT ON THE MAIN FUEL CONTROL WHEN THE RIGGING PORT PLUG IS REMOVED. THE FUEL MAY IRRITATE THE EYES AND SKIN.

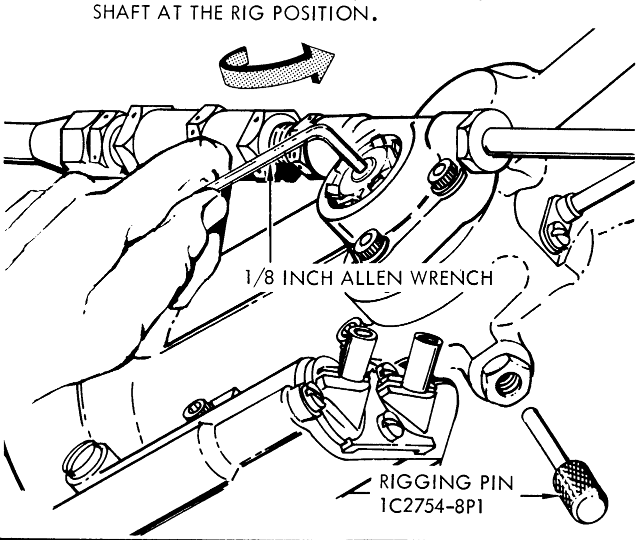
a REMOVE THE PLUG FROM THE VARIABLE VANE RIGGING PORT ON THE MAIN FUEL CONTROL.



CAUTION

IN THE FOLLOWING STEP, THE VARIABLE VANE FEEDBACK SHAFT IS SPRING-LOADED IN THE MAIN FUEL CONTROL. DO NOT RELEASE THE SHAFT OR ALLOW THE SHAFT TO SNAP-BACK. THIS MAY DAMAGE THE MAIN FUEL CONTROL STOPS.

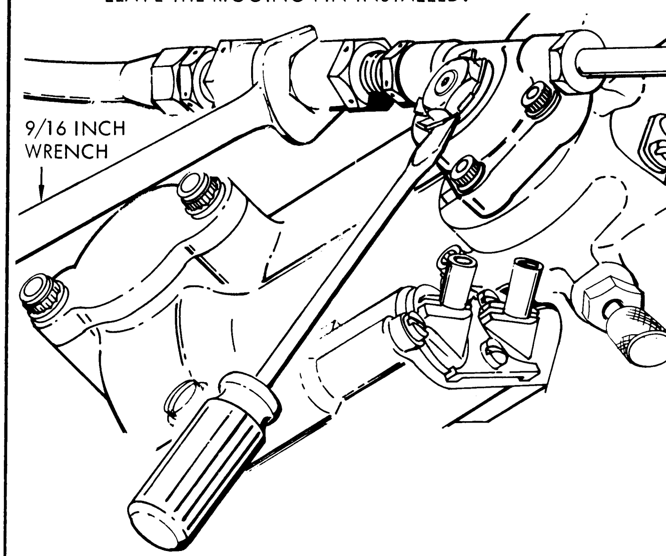
b INSERT AN ALLEN WRENCH IN THE FEEDBACK SHAFT, ROTATE THE SHAFT APPROXIMATELY 3/4 TURN COUNTERCLOCKWISE AGAINST THE SPRING TENSION, AND INSERT RIGGING PIN, 1C2754-8P1, TO HOLD THE SHAFT AT THE RIG POSITION.

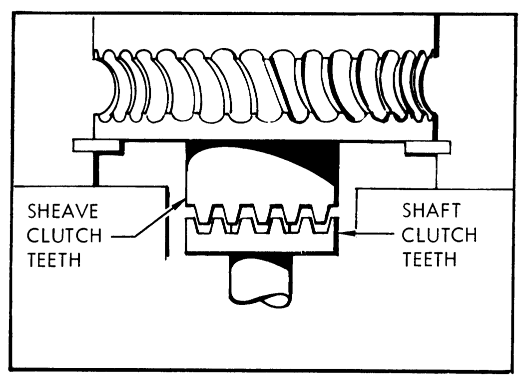


NOTE

IN THE FOLLOWING STEP, A SCREWDRIVER MAY BE INSERTED UNDER THE LOCKNUT TO GENTLY PRY THE SHAFT OUTWARD TO ASSIST ENGAGEMENT.

c PULL THE FEEDBACK SHAFT OUTWARD. WHEN THE SHAFT CLUTCH TEETH CONTACT THE CABLE BOX SHEAVE CLUTCH TEETH, LOOSEN THE MICRO-ADJUST UNIT JAM NUTS, AND TURN THE COUPLING WITH A 9/16 INCH WRENCH, UNTIL THE SHAFT AND SHEAVE CLUTCH TEETH ARE PARTIALLY ENGAGED. LEAVE THE RIGGING PIN INSTALLED.





d CONTINUE TO PULL THE FEEDBACK SHAFT OUTWARD, TO GET TOTAL CLUTCH ENGAGEMENT; TURN THE MICRO-ADJUST UNIT IF NECESSARY. TIGHTEN THE FEEDBACK SHAFT LOCKNUT FINGERTIGHT.

e REMOVE THE RIGGING PIN.

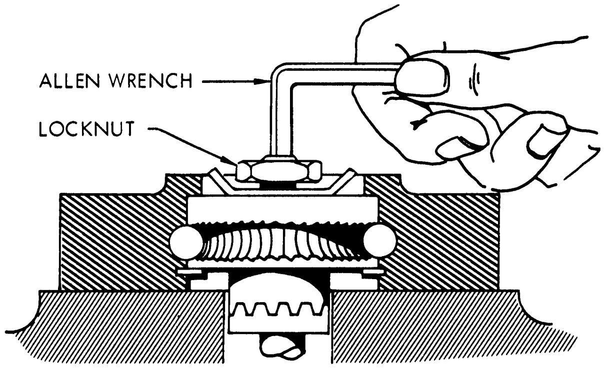
J79-B3358-1-A2

4C-2-8-(31-7)

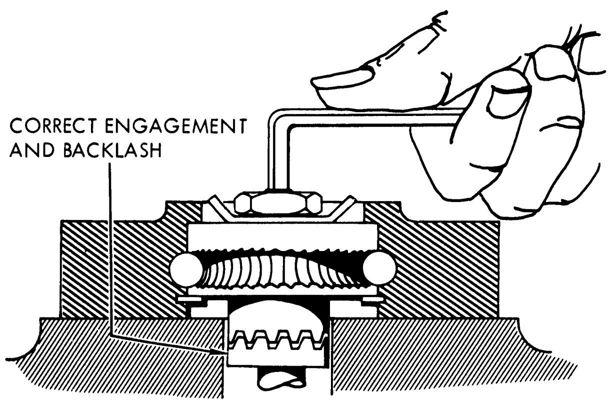
Figure 4-12. Variable Vane Feedback Linkage (Sheet 7 of 10)

10 CLUTCH ENGAGEMENT CHECK

a HOLD THE FEEDBACK SHAFT WITH THE ALLEN WRENCH, MARK ONE FLAT ON THE LOCKNUT, AND LOOSEN THE LOCKNUT EXACTLY 1/2 TURN.



b PUSH THE SHAFT IN WITH THE ALLEN WRENCH AND TRY TO ROTATE THE SHAFT IN BOTH DIRECTIONS. IF THE SHAFT WILL NOT TURN MORE THAN THE CLUTCH TEETH BACKLASH PERMITS, THE ENGAGEMENT IS CORRECT. IF CLUTCH ENGAGEMENT IS NOT CORRECT, THE SHAFT WILL "FREE-WHEEL", AND MUST BE ENGAGED AGAIN.



c **HOLD THE SHAFT WITH THE ALLEN WRENCH AND TORQUE THE LOCKNUT TO 30 TO 40 LB–IN. DO NOT BEND THE TAB-WASHER AT THIS TIME.**

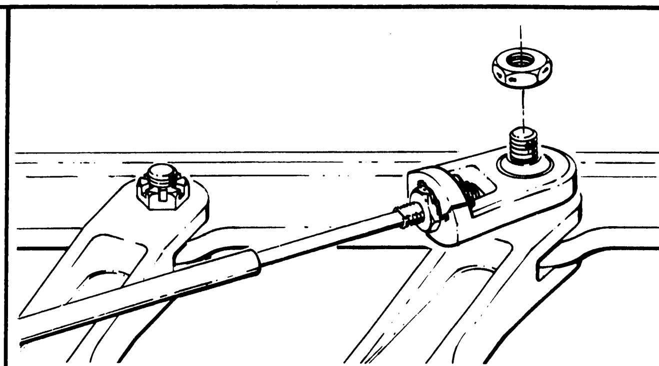
11 INSPECTION FOR CABLE BINDING

CAUTION

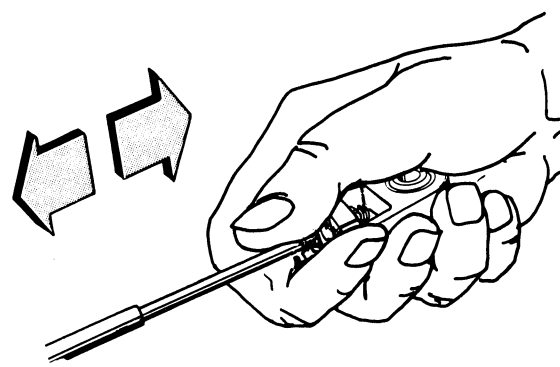
GAIN ACCESS TO THE FIRST STAGE BELL-CRANK CLEVIS BOLT THROUGH THE BYPASS BELLMOUTH. TAKE PRECAUTIONS TO BE SURE HARDWARE ITEMS/TOOLS DO NOT CAUSE FOD TO THE ENGINE COMPRESSOR.

IN THE FOLLOWING STEP, THE CABLE IS SPRING-LOADED TOWARD THE MAIN FUEL CONTROL AND THE FEEDBACK SHAFT IS UNDER SPRING TENSION. SNAP-BACK CAN DAMAGE THE MAIN FUEL CONTROL STOPS.

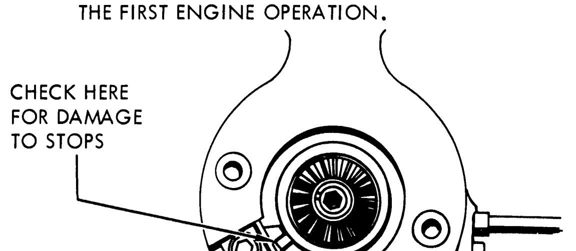
a REMOVE THE ROD-END BEARING RETAINING NUT FROM THE FIRST-STAGE BELLCRANK CLEVIS BOLT.



b HOLD THE ROD-END BEARING FIRMLY, SEPARATE THE ROD-END BEARING FROM THE CLEVIS BOLT, AND ALLOW THE SPRING TENSION TO RETRACT THE CABLE SLOWLY, AGAINST THE MAIN FUEL CONTROL STOP. PULL THE CABLE OUT TO THE STOP AND LET THE CABLE RETRACT SLOWLY AGAIN. DO THIS SEVERAL TIMES TO DETERMINE THAT THE CABLE TRAVEL IS SMOOTH. DO NOT LET THE CABLE SNAP-BACK.



c IF A SNAP-BACK DOES OCCUR, REMOVE THE FEEDBACK LINKAGE, AND INSPECT THE MAIN FUEL CONTROL FEEDBACK SHAFT STOPS (UNDER THE CABLE BOX) VISUALLY FOR BREAKAGE OR DISTORTION. IF DAMAGE IS FOUND, REPLACE THE FUEL CONTROL. IF THERE IS NO DAMAGE, REASSEMBLE THE LINKAGE AND CYCLE THE CABLE FROM STOP TO STOP, SEVERAL TIMES, TO BE SURE THAT TRAVEL IS SMOOTH. CHECK THE VARIABLE VANE SCHEDULE CAREFULLY, DURING THE FIRST ENGINE OPERATION.



d REINSTALL THE ROD-END BEARING ON THE CLEVIS BOLT AND SECURE THE BEARING WITH THE RETAINING NUT.

e **TORQUE THE NUT TO 20 TO 30 LB–IN. AND LOCKWIRE TO THE CLEVIS BOLT.**

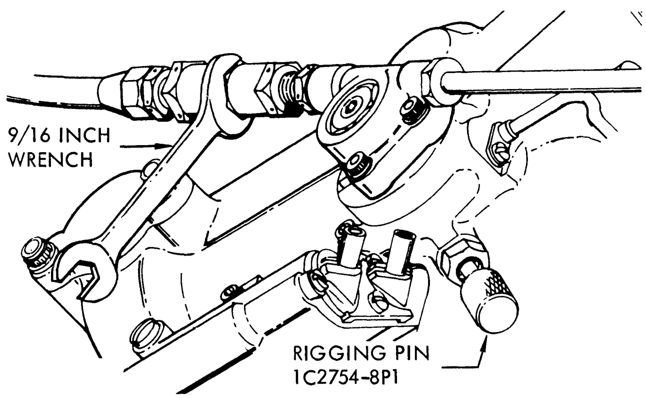
4C–2–8–(31–8)B

Figure 4-12. Variable Vane Feedback Linkage (Sheet 8 of 10)

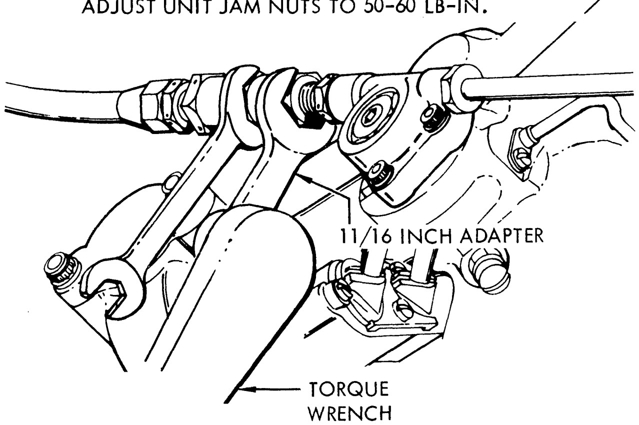
12 RIGGING CHECK

a INSERT THE RIGGING PIN IN THE MAIN FUEL CONTROL RIGGING PORT.

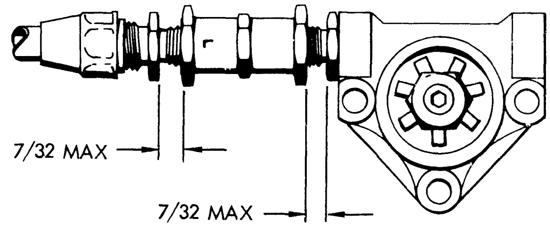
b TURN THE MICRO-ADJUST UNIT, IF NECESSARY, UNTIL THE RIGGING PIN FITS FREELY. DO NOT ROTATE THE MICRO-ADJUST COUPLING MORE THAN 1/2 TURN IN EITHER DIRECTION.



c REMOVE THE RIGGING PIN. TORQUE THE MICRO-ADJUST UNIT JAM NUTS TO 50-60 LB-IN.



d MEASURE THE DISTANCE BETWEEN EACH JAM NUT AND THE CORRESPONDING CONNECTOR HEX. IF THE MEASUREMENT EXCEEDS 7/32 INCH, RE-RIG THE SYSTEM.

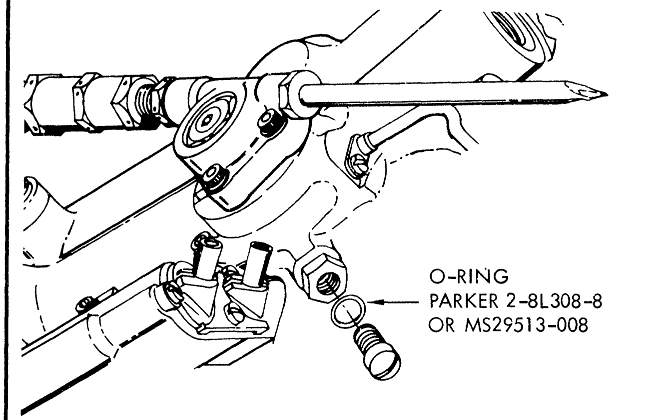


e DISCONNECT THE PRESSURIZER, 1C3568G1, FROM THE VARIABLE VANE ACTUATOR MANIFOLDS. CONNECT THE HEAD-END AND ROD-END HOSES TO THESE MANIFOLDS; TORQUE THE COUPLING NUTS TO 450-550 LB-IN. AND LOCKWIRE.

13 FINAL INSTALLATION

a ASSEMBLE A NEW O-RING (PARKER 2-8L308-8) ON THE RIGGING PORT PLUG AND INSTALL IN THE RIGGING PORT.

b TORQUE THE PLUG TO 20-30 LB-IN. AND LOCKWIRE TO THE ADJACENT PLUG.



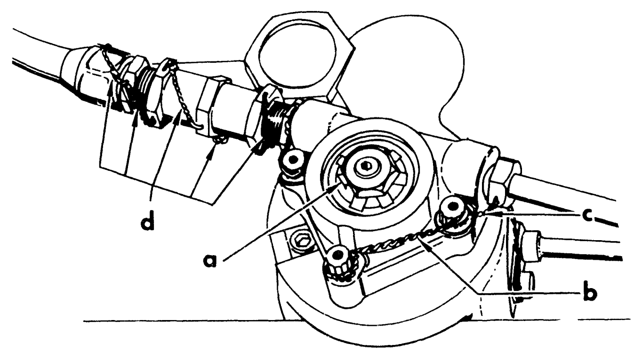
14 SECURING THE SYSTEM

a BEND A TAB OF THE TABWASHER AGAINST A LOCKNUT FLAT TO SECURE THE LOCKNUT TO THE FEEDBACK SHAFT.

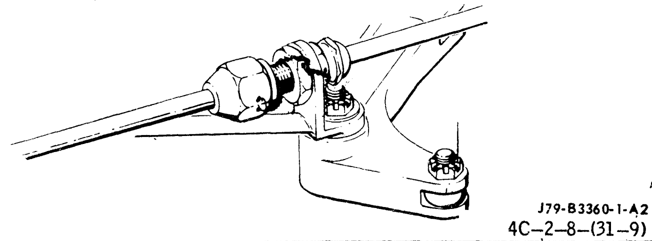
b LOCKWIRE THE TWO LOWER MOUNTING BOLTS ON THE CABLE BOX.

c LOCKWIRE THE OVERTRAVEL TUBE TO THE NEAREST CABLE BOX MOUNTING BOLT.

d LOCKWIRE THE CONDUIT COUPLING NUT TO THE MICRO-ADJUST UNIT AND THEN TO THE NEAREST CABLE BOX MOUNTING BOLT.



e LOCKWIRE THE CONDUIT COUPLING NUT (AT THE THIRD-STAGE BELLCRANK) TO THE JAM NUT AND THEN TO THE SWIVEL ASSEMBLY.



J79-B3360-1-A2
4C-2-8-(31-9)

Figure 4-12. Variable Vane Feedback Linkage (Sheet 9 of 10)

RIGGING (RUNNING NULL)

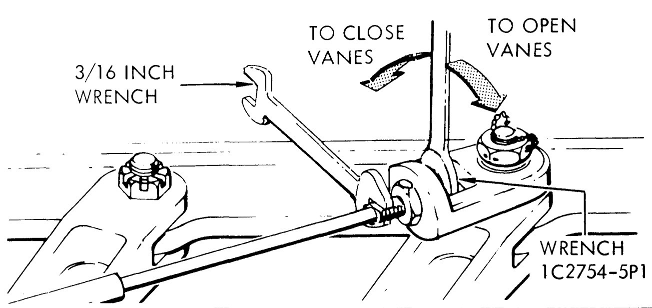
1 LINKAGE ADJUSTMENT*

NOTE

THE VARIABLE VANE FEEDBACK LINKAGE CAN BE PROPERLY RIGGED ONLY WHILE THE ENGINE IS RUNNING. THIS IS COMMONLY CALLED "SETTING THE RUNNING NULL" AND IS PERFORMED DURING THE FUNCTIONAL ENGINE TEST. THE VANE POSITION ESTABLISHED DURING THE RUNNING NULL IS NOT THE SAME AS THAT SET DURING INSTALLATION OF THE LINKAGE. THE RUNNING NULL SCHEDULE IS FOUND IN SECTION II. THERE IS NO "STATIC" VANE POSITION AT WHICH THE RUNNING NULL CAN BE CHECKED AFTER THE ENGINE HAS BEEN SHUTDOWN.

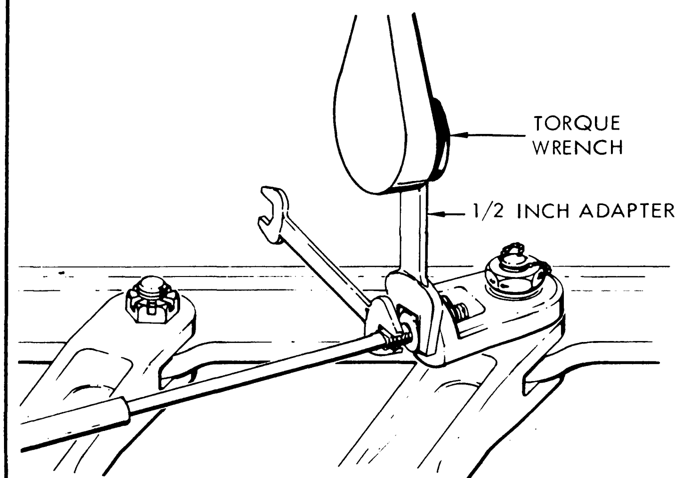
a MAKE SURE THAT THE REMOTE VANE POSITION INDICATOR HAS BEEN INDEXED WITH THE ENGINE VPI.

b HOLD THE FLAT ON THE CABLE ROD WITH A 3/16 INCH WRENCH, LOOSEN THE ROD-END BEARING JAM NUT, AND USE WRENCH, 1C2754-5P1, ON THE ADJUSTMENT NUT TO SET THE REQUIRED SCHEDULE. DO NOT LET THE CABLE ROTATE WHEN MAKING THIS ADJUSTMENT. ONE TURN OF THE ADJUSTMENT NUT EQUALS 1/2 DEGREE VPI CHANGE.

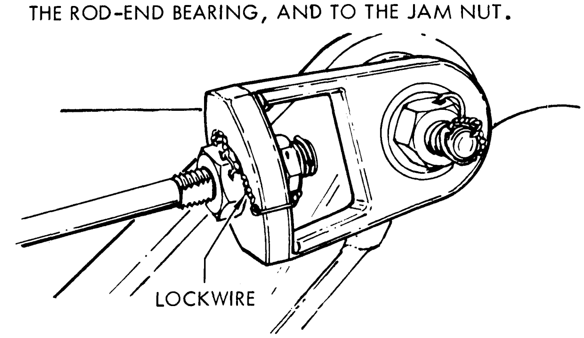


2 SECURING

a HOLD THE FLAT ON THE CABLE ROD WITH A 3/16 INCH WRENCH, TORQUE THE ROD-END BEARING JAM NUT TO 27-35 LB-IN.

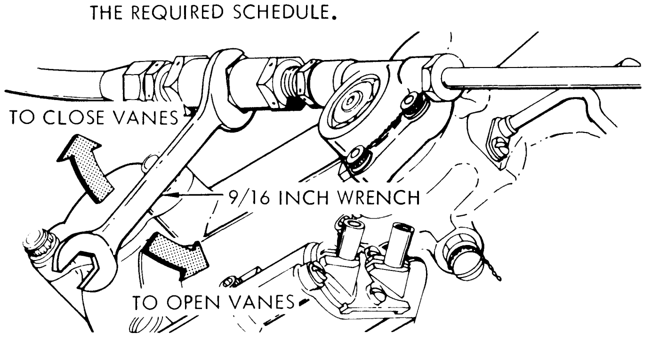


b LOCKWIRE FROM THE HOLE IN THE CABLE ROD TO THE ADJUSTMENT NUT, THROUGH THE HOLE IN THE ROD-END BEARING, AND TO THE JAM NUT.



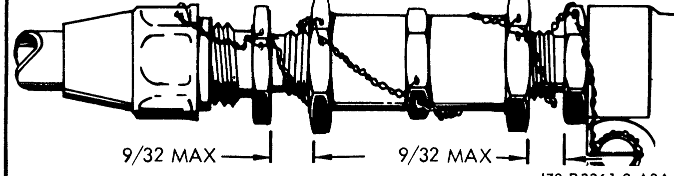
* ALTERNATE LINKAGE ADJUSTMENT

a LOOSEN THE MICRO-ADJUST UNIT JAM NUTS AND USE A 9/16 INCH WRENCH ON THE COUPLING TO SET THE REQUIRED SCHEDULE.



b TORQUE THE MICRO-ADJUST UNIT JAM NUTS TO 50-60 LB-IN. IF THE DISTANCE BETWEEN THE JAM NUTS AND THE NEAREST CONNECTOR HEX EXCEEDS 9/32 INCH, POSITIVE ENGAGEMENT OF THE CONNECTORS IN THE COUPLING IS NOT CORRECT; RE-RIG THE SYSTEM.

c LOCKWIRE THE CONDUIT COUPLING NUT TO THE MICRO-ADJUST UNIT AND THEN TO THE NEAREST CABLE BOX MOUNTING BOLT.



4C-2-8-(31-10)

Figure 4-12. Variable Vane Feedback Linkage (Sheet 10 of 10)

4-94. NOZZLE FEEDBACK LINKAGE.

4-95. Tools and Equipment.

Pressurizing unit, nozzle actuator
Set, rigging
Scale, spring, 0 to 200 pounds

4-96. Materials.

Lockwire, MS20995NC32

4-97. Manpower Requirements.

a. Two men required

4-98. Removal.

a. Open door 83L or R.

b. See figure 4-13 for remainder of procedure.

4-99. **Cleaning.** Refer to paragraph 4-142 for cable and conduit cleaning procedures.

4-100. **Inspection.** Inspect cables and feedback box sheave cover as follows:

a. Inspect cable (helix) outside diameter. Reject forward cable measuring 0.240 inch or less in 12 inch length at cable box (forward) end. Reject cables measuring 0.225 inch or less in all other areas.

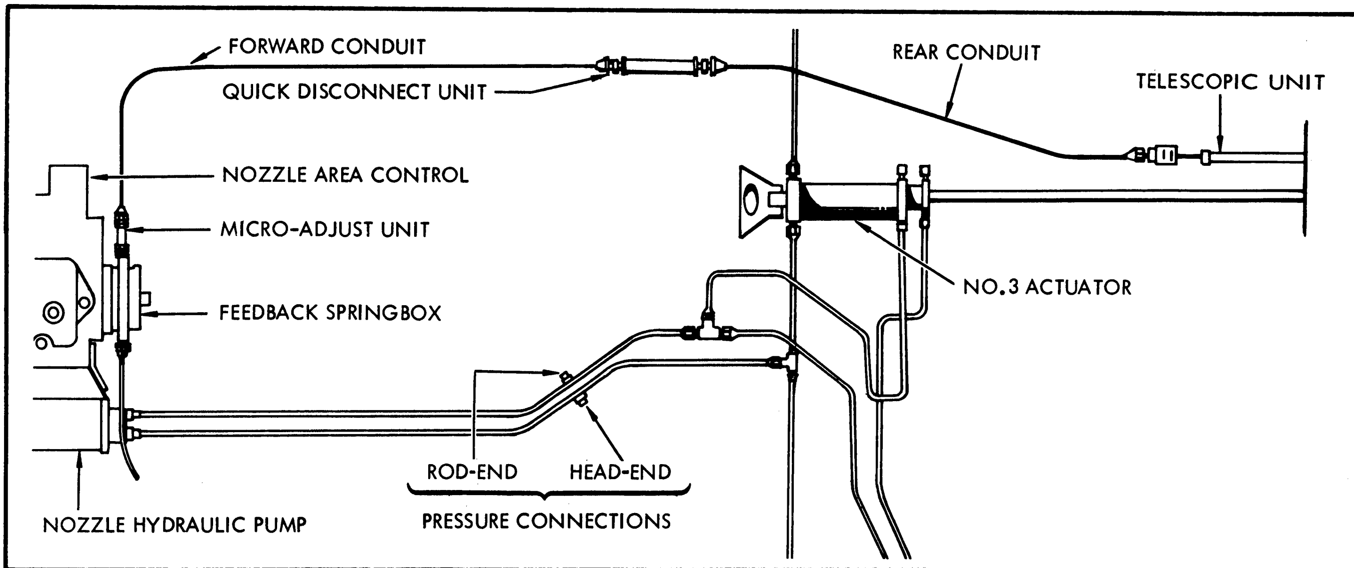
NOTE

Remove high metal and measure cable diameter in accordance with step a.

b. Inspect for nicks and cuts in helix wire. Reject cable having nicks and cuts exceeding 0.010 inch.

4-101. **Lubrication.** Refer to paragraph 4-147 for cable lubrication procedure.

4-102. **Installation.** See figure 4-13.



REMOVAL

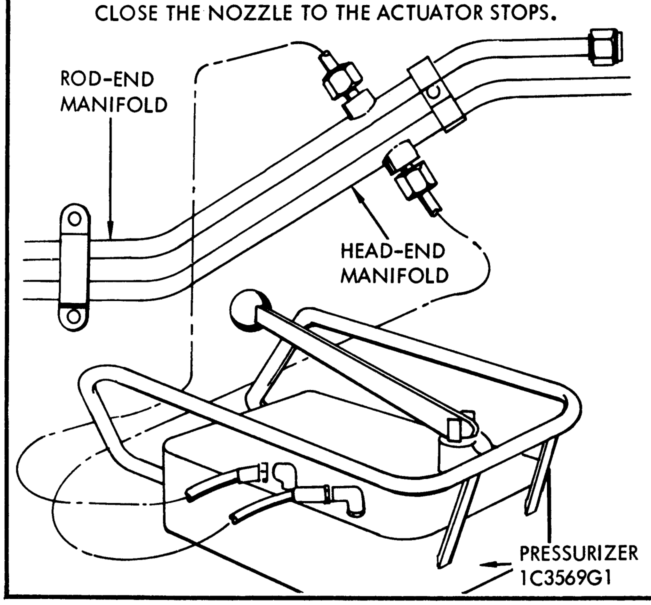
1 CABLE RELEASE

a REMOVE THE PRESSURE CAPS FROM THE NOZZLE ACTUATOR HEAD-END AND ROD-END SUPPLY MANIFOLDS.

CAUTION

IN THE FOLLOWING STEP, DO NOT PERMIT PRESSURIZER OPERATING PRESSURE TO EXCEED 300 PSI, WHILE ACTUATING THE EXHAUST NOZZLE.

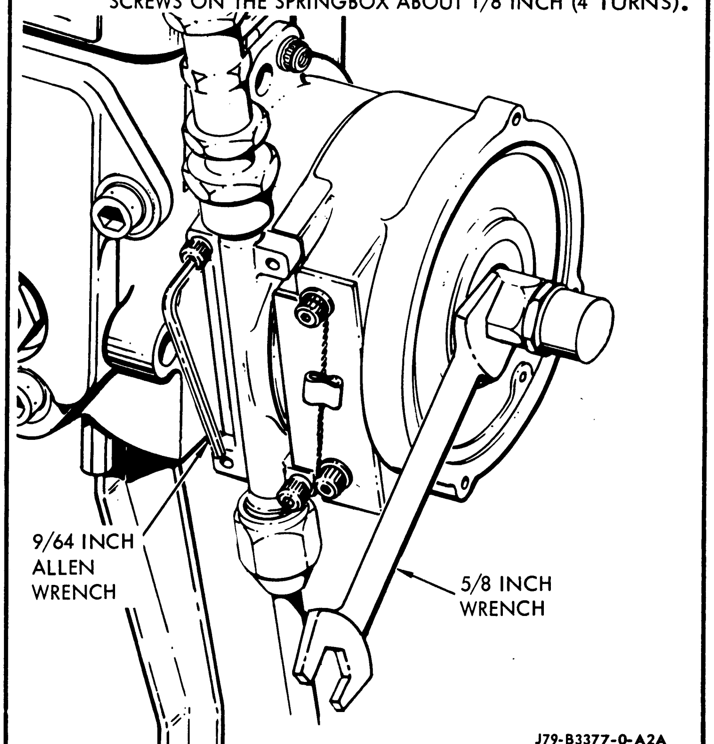
b CONNECT NOZZLE ACTUATOR PRESSURIZER, 1C3569G1, TO THE NOZZLE ACTUATOR SUPPLY MANIFOLDS, AND CLOSE THE NOZZLE TO THE ACTUATOR STOPS.



CAUTION

IN THE FOLLOWING STEPS, THE NOZZLE FEEDBACK CABLE IS SPRING-LOADED IN THE NOZZLE AREA CONTROL SPRINGBOX. DO NOT LET THE CABLE RETRACT SUDDENLY, THIS MAY DAMAGE THE CONTROL.

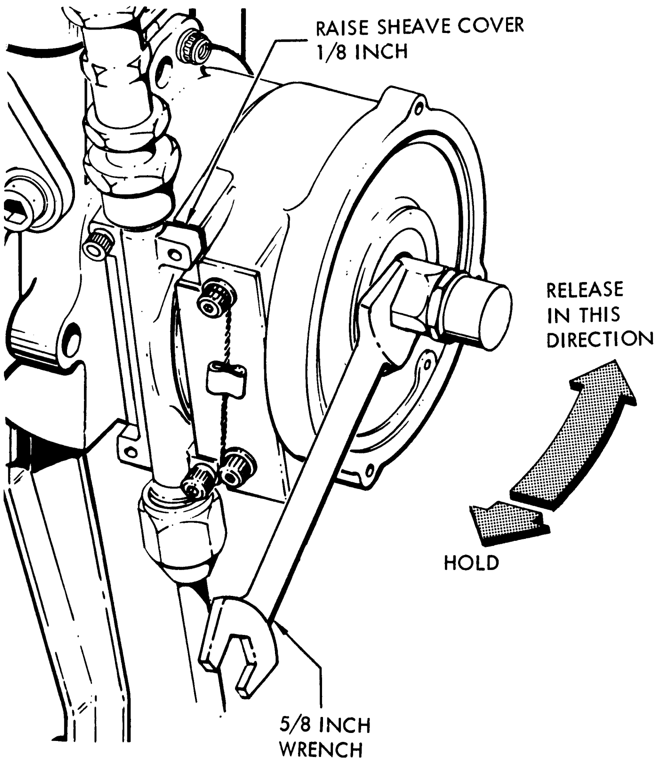
c HOLD THE SPRINGBOX ARBOR SHAFT WITH A 5/8 INCH OPEN-END WRENCH AND LOOSEN THE SHEAVE COVER SCREWS ON THE SPRINGBOX ABOUT 1/8 INCH (4 TURNS).



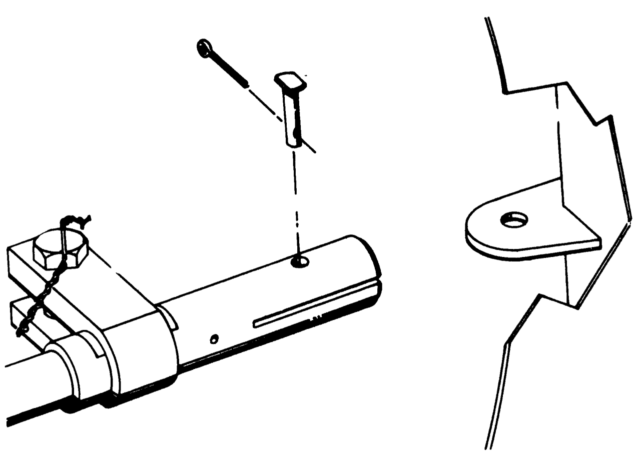
4C-2-8-(33-1)

Figure 4-13. Variable Nozzle Feedback Linkage (Sheet 1 of 13)

1d ROTATE THE SPRINGBOX ARBOR SHAFT SLIGHTLY CLOCKWISE TO RELIEVE ANY PRESSURE ON THE CABLE. RAISE THE SHEAVE COVER ABOUT 1/8 INCH TO DISENGAGE THE CABLE FROM THE SHEAVE, AND SLOWLY RELEASE THE REMAINING SPRINGBOX TORQUE WITH THE WRENCH.



e DISCONNECT THE TELESCOPIC UNIT OUTER SLIDER FROM THE EXHAUST NOZZLE MOUNTING BRACKET BY REMOVING THE COTTER PIN AND MOUNTING PIN.

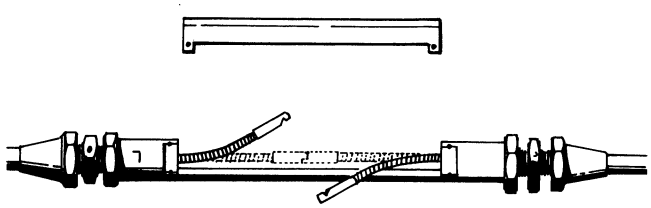


2 **CABLE REMOVAL**

CAUTION

IN THE FOLLOWING STEP, DAMAGE TO THE CABLE TERMINALS MAY RESULT IF EXCESSIVE FORCE IS USED IN SEPARATING THE FORWARD AND REAR CABLES. DO NOT PRY THE CABLE TERMINALS APART.

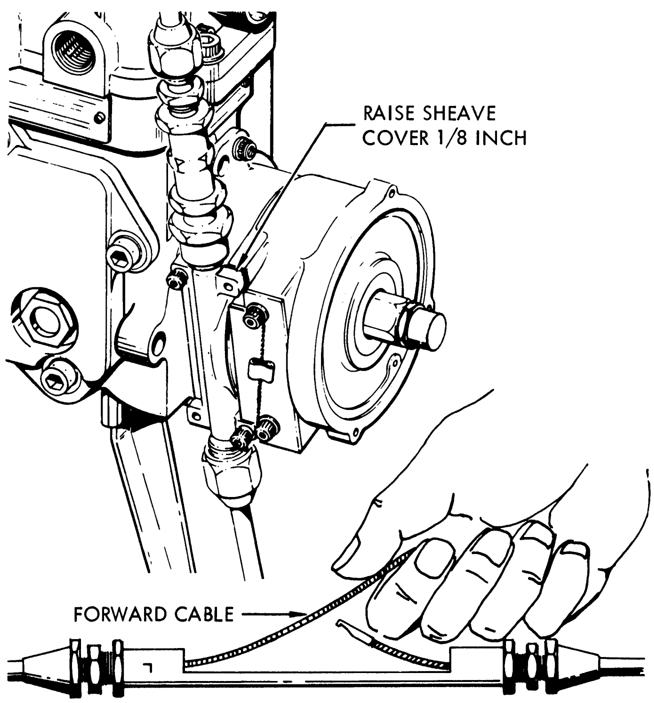
a REMOVE THE COVER FROM THE QUICK-DISCONNECT UNIT AND SEPARATE THE CABLES.



CAUTION

IN THE FOLLOWING STEPS, TO AVOID SERIOUS DAMAGE TO THE CABLES OR CONDUIT, REMOVE BOTH SECTIONS OF CABLE FROM THE QUICK-DISCONNECT UNIT. DO NOT ATTEMPT TO REMOVE THE CABLES FROM THE FORWARD OR REAR ENDS OF THE CONDUIT.

b RAISE THE SHEAVE COVER ON THE SPRINGBOX, AND REMOVE THE FORWARD CABLE FROM THE CONDUIT AT THE QUICK-DISCONNECT UNIT.

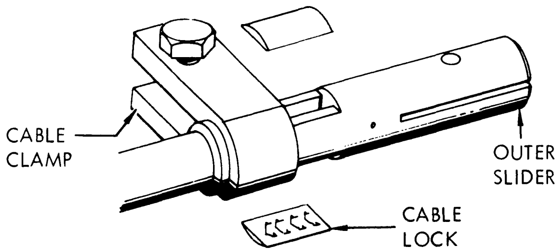


4C-2-8-(33-2)

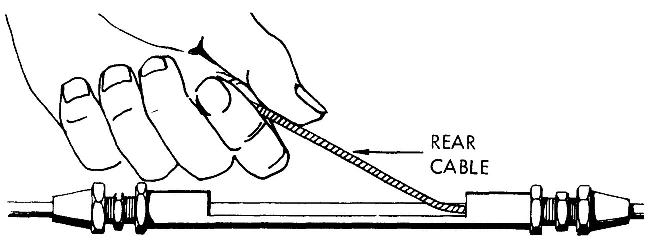
Figure 4-13. Variable Nozzle Feedback Linkage (Sheet 2 of 13)

2

c LOOSEN THE CABLE CLAMP ON THE TELESCOPIC UNIT OUTER SLIDER, PUSH THE CLAMP FORWARD, AND REMOVE THE TWO CABLE LOCKS. REMOVE THE TELESCOPIC UNIT OUTER SLIDER FROM THE CABLE.



d REMOVE THE REAR CABLE FROM THE REAR CONDUIT AT THE QUICK-DISCONNECT UNIT.

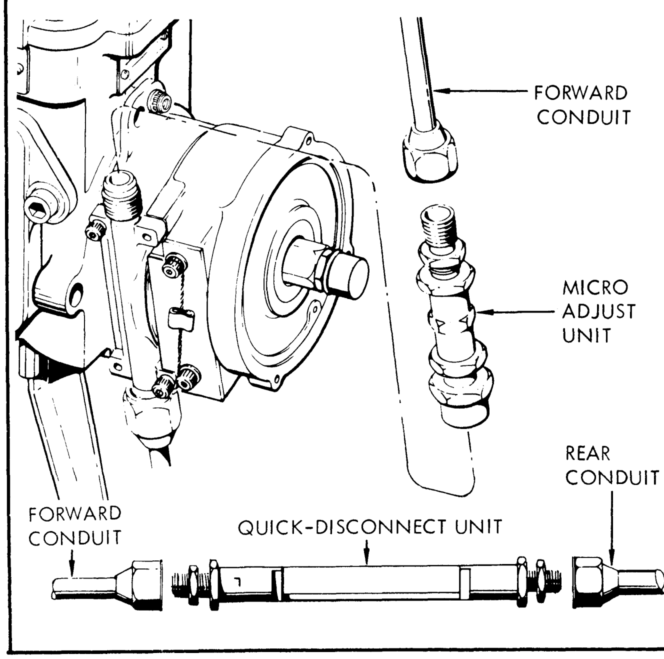


e ACTUATE THE NOZZLE TO THE OPEN POSITION.

3 **COMPLETE DISASSEMBLY**

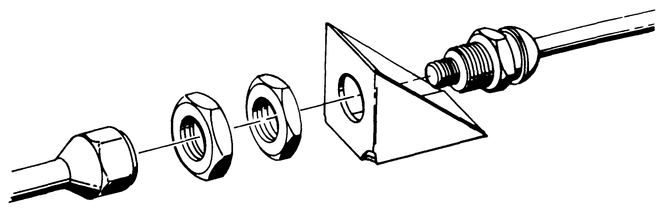
a DISCONNECT THE FORWARD CONDUIT AT THE MICRO-ADJUST AND QUICK-DISCONNECT UNITS.

b REMOVE THE MICRO-ADJUST UNIT FROM THE NOZZLE AREA CONTROL SPRINGBOX, AND THE QUICK-DISCONNECT UNIT FROM THE REAR CONDUIT.



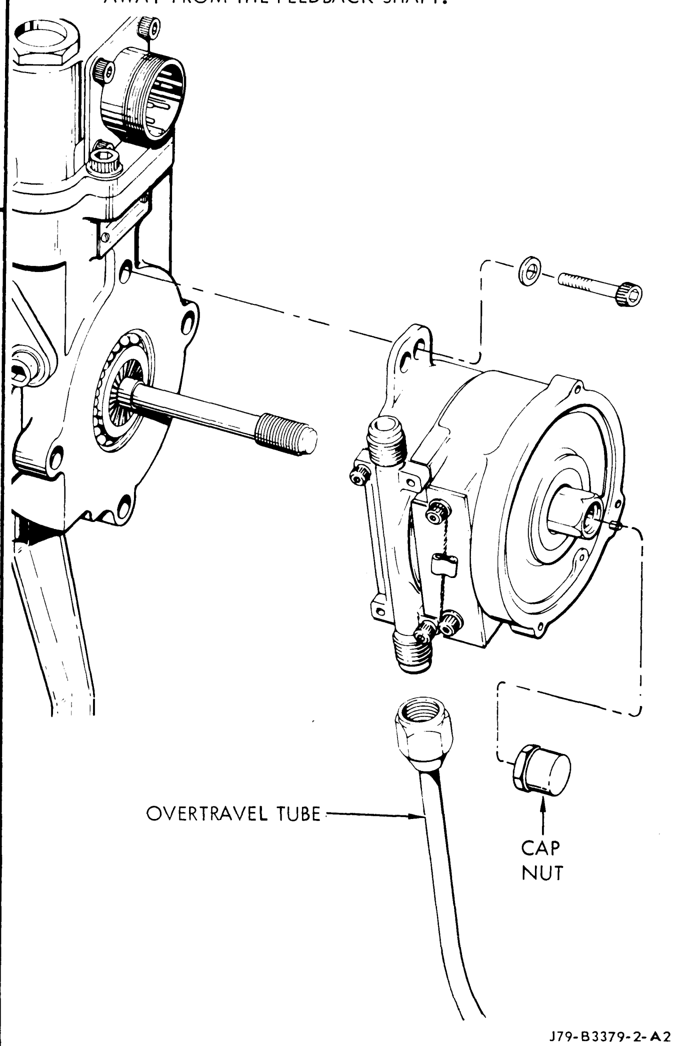
c REMOVE THE REAR CONDUIT FROM THE TELESCOPIC UNIT SWIVEL ASSEMBLY.

d REMOVE THE TELESCOPIC UNIT SWIVEL ASSEMBLY FROM THE MOUNTING BRACKET ON THE TAILPIPE.



e REMOVE THE OVERTRAVEL TUBE ON THE NOZZLE AREA CONTROL SPRINGBOX.

f REMOVE THE SPRINGBOX FROM THE NOZZLE AREA CONTROL: REMOVE THE CAP NUT FROM THE FEEDBACK SHAFT; REMOVE THE THREE MOUNTING BOLTS AND WASHERS; PULL THE SPRINGBOX STRAIGHT OUT, AWAY FROM THE FEEDBACK SHAFT.



4C-2-8-(33-3)

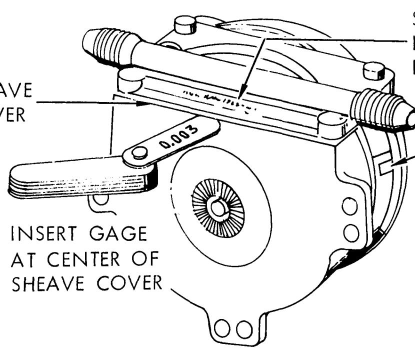
Figure 4-13. Variable Nozzle Feedback Linkage (Sheet 3 of 13)

INSTALLATION

1 PRELIMINARY INSPECTION

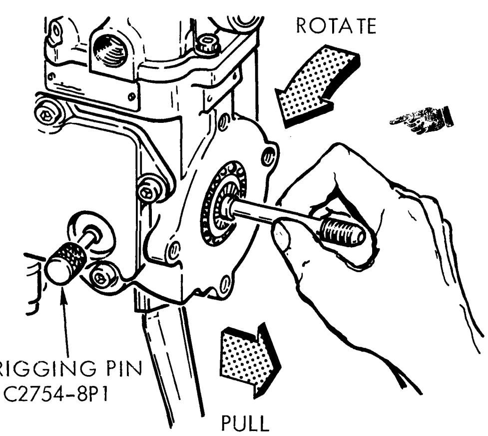
a COMPARE THE SERIAL NUMBERS OF THE SPRINGBOX AND THE SHEAVE COVER. THE SERIAL NUMBERS MUST MATCH; IF THE NUMBERS DO NOT MATCH, OR ARE UNREADABLE, REPLACE THE SPRINGBOX AND SHEAVE COVER TOGETHER.

b INSPECT THE SPRINGBOX SHEAVE COVER FOR DISTORTION. WITH THE SHEAVE COVER SCREWS TIGHT, TRY TO INSERT A 0.003 INCH FEELER GAGE BETWEEN THE SPRINGBOX AND SHEAVE COVER FLANGE. IF THE GAGE FITS; THE COVER AND SPRINGBOX MUST BE REPLACED, SINCE BOTH HAVE THE SAME SERIAL NUMBER AND MUST BE REPLACED TOGETHER.

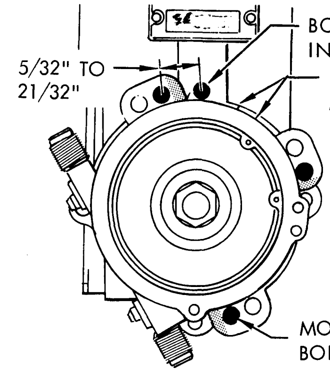


2 SPRINGBOX INSTALLATION

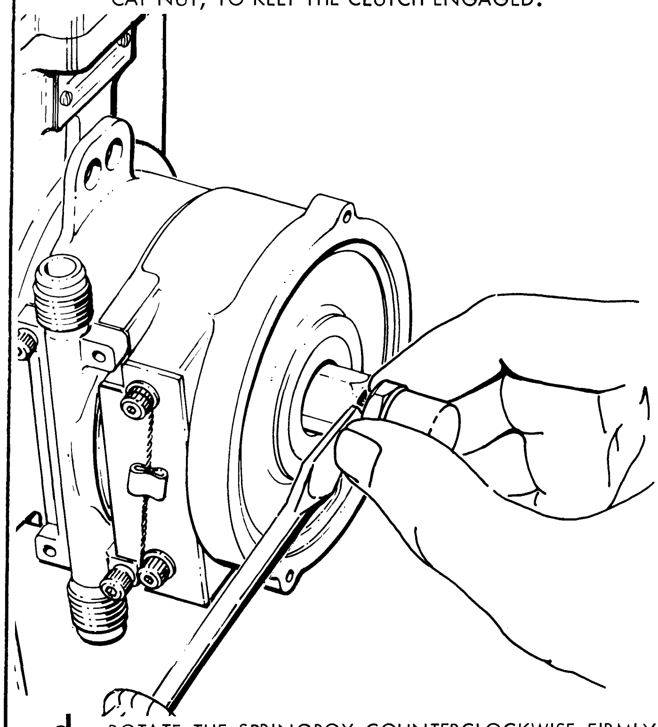
a ROTATE THE NOZZLE AREA CONTROL FEEDBACK SHAFT FROM STOP TO STOP, CHECKING FOR FREEDOM OF MOVEMENT. ROTATE THE SHAFT UNTIL RIGGING PIN, 1C2754-8P1, CAN BE INSTALLED AND PULL THE SHAFT OUTWARD AS FAR AS POSSIBLE. THE SHAFT SHOULD NOT ROTATE WITH THE RIGGING PIN INSTALLED. ROTATION INDICATES A SHEARED TAPER PIN IN THE SHAFT ASSEMBLY AND THE CONTROL SHOULD BE RETURNED TO OVERHAUL. REMOVE THE RIGGING PIN AND ROTATE THE SHAFT COUNTERCLOCKWISE TO THE STOP.



b PLACE THE SPRINGBOX OVER THE FEEDBACK SHAFT SO THAT THE AREA OF THE MOUNTING LUG (SHADED IN THE VIEW) IS LOCATED OVER THE BOLT HOLE IN THE N.A.C. ROTATE THE SPRINGBOX COUNTERCLOCKWISE UNTIL THE CLUTCH TEETH OF THE SHEAVE MESH WITH THE FEEDBACK SHAFT CLUTCH TEETH. WHEN PROPERLY ENGAGED THE CENTER OF THE MOUNTING BOLT HOLE SHOULD BE 5/32" TO 21/32" FROM THE CENTER OF THE BOLT HOLE IN THE N.A.C.



c INSTALL THE CAP NUT ON THE FEEDBACK SHAFT FINGERTIGHT. USE A SCREWDRIVER UNDER THE CAP NUT TO PRY OUT ON THE SHAFT, WHILE TIGHTENING THE CAP NUT, TO KEEP THE CLUTCH ENGAGED.



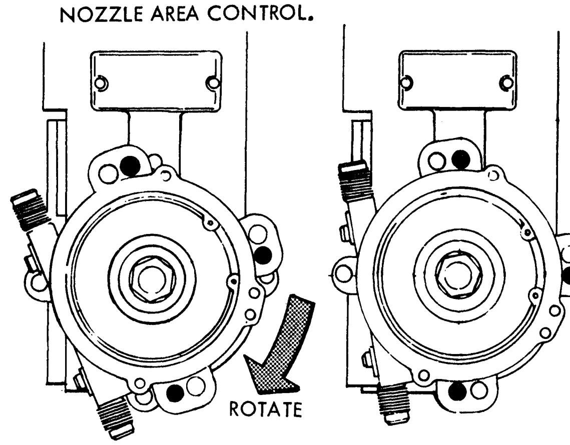
d ROTATE THE SPRINGBOX COUNTERCLOCKWISE FIRMLY AGAINST THE STOP. THE CLUTCH MUST STAY ENGAGED AND THE BOLT HOLE DIMENSION MUST REMAIN IN LIMITS. IF PRESENT, THE SCRIBE MARK ON THE BOX MUST BE BETWEEN THE TWO MARKS ON THE NOZZLE AREA CONTROL.

J79-B3380-4-A2A

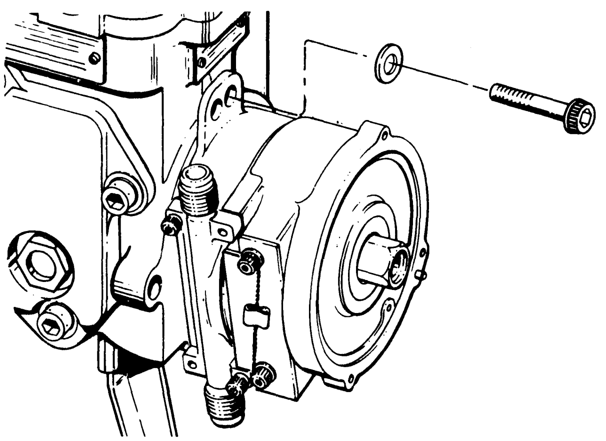
4C-2-8-(33-4)A

Figure 4-13. Variable Nozzle Feedback Linkage (Sheet 4 of 13)

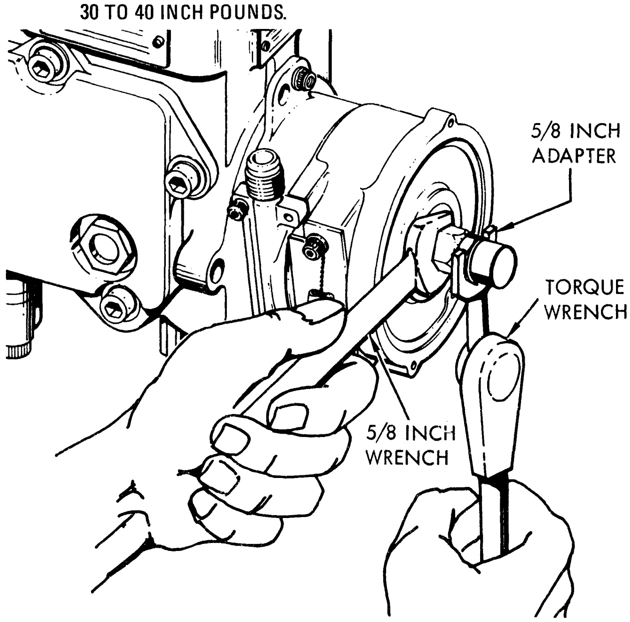
2 e ROTATE THE SPRINGBOX CLOCKWISE JUST ENOUGH TO ALIGN THE FIRST SET OF SPRINGBOX MOUNTING BOLT HOLES WITH THE MOUNTING HOLES ON THE NOZZLE AREA CONTROL.



f INSTALL THE THREE MOUNTING BOLTS AND WASHERS; TORQUE 30 TO 40 INCH POUNDS AND LOCKWIRE. THE SCRIBE MARKS WILL NO LONGER BE ALIGNED.



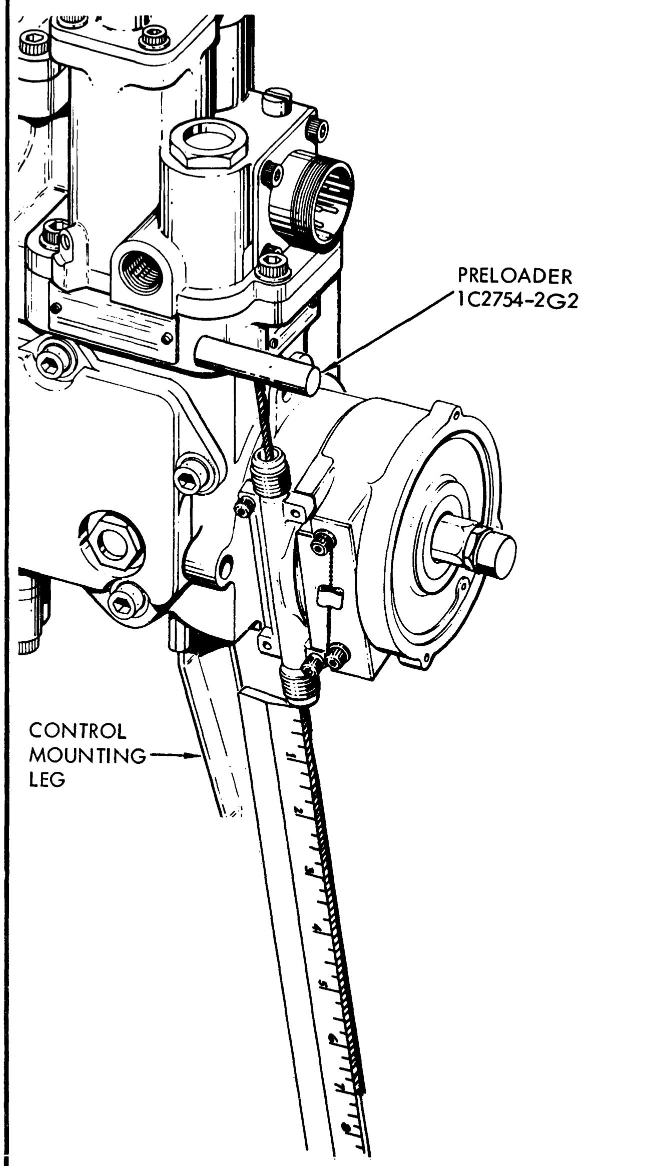
g HOLD THE SPRINGBOX ARBOR SHAFT WITH A 5/8 INCH OPEN-END WRENCH, AND TORQUE THE CAP NUT TO 30 TO 40 INCH POUNDS.



3 INSTALLATION CHECK

a LOOSEN THE SHEAVE COVER SCREWS ON THE SPRINGBOX AND RAISE THE COVER ABOUT 1/8 INCH. INSERT PRELOADER, 1C2754-2G2, INTO THE SPRINGBOX FROM THE OPPOSITE SIDE OF THE CONTROL MOUNTING LEGS. LET ABOUT SEVEN INCHES OF THE PRELOADER EXTEND FROM THE OVERTRAVEL TUBE END OF THE BOX. SEAT THE SHEAVE COVER BY HAND, CAREFULLY MESHING THE CABLE WITH THE SHEAVE. TIGHTEN THE COVER SCREWS.

b PULL THE CABLE TO ROTATE THE FEEDBACK SHAFT FROM STOP TO STOP. THE SHAFT IS SPRING-LOADED; DO NOT PERMIT A SNAP BACK. CHECK FOR FREEDOM AND DISTANCE OF TRAVEL, WHICH MUST BE AT LEAST 6-1/2 INCHES. MEASURE AT THE OVERTRAVEL TUBE END. IF THE 6-1/2 INCH TRAVEL CANNOT BE MET, INSPECT THE SEATING OF THE BOX. IF THE SEATING IS PROPER, AND THE DIMENSIONS CANNOT BE MET, REPLACE THE SPRINGBOX AND SHEAVE COVER, OR THE NOZZLE AREA CONTROL.

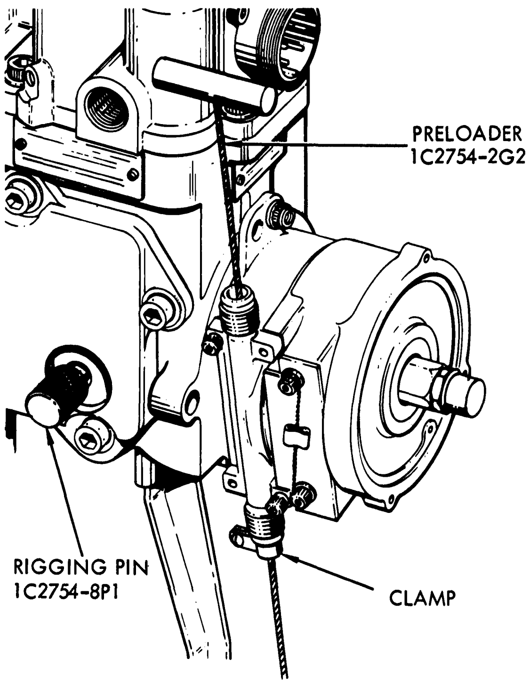


4C-2-8-(33-5)C

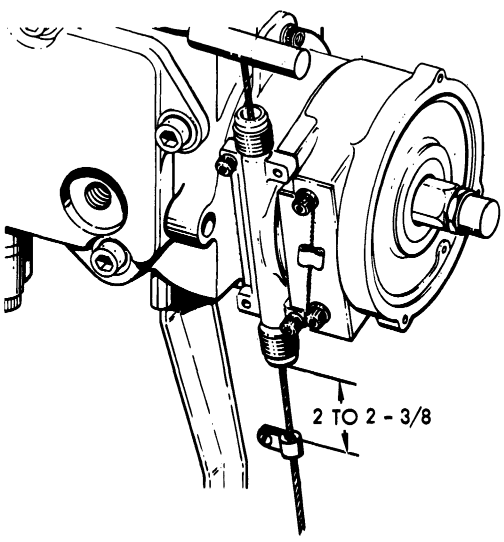
Figure 4-13. Variable Nozzle Feedback Linkage (Sheet 5 of 13)

c REMOVE THE PLUG FROM THE RIGGING PORT ON THE NOZZLE AREA CONTROL. PULL THE PRELOADER OUT UNTIL RIGGING PIN, 1C2754-8P1, CAN BE INSERTED; INSERT THE RIGGING PIN.

d PLACE A CLAMP ON THE PRELOADER, AT THE OVER-TRAVEL TUBE SIDE, TIGHT AGAINST THE SHEAVE COVER.



e HOLD THE PRELOADER, REMOVE THE RIGGING PIN, AND LET THE PRELOADER RETRACT SLOWLY TO THE STOP. MEASURE HOW FAR THE CLAMP HAS MOVED AWAY FROM THE SHEAVE COVER. THE DISTANCE MUST BE BETWEEN 2 AND 2-3/8 INCHES; IF NOT, CHECK THE SPRINGBOX FOR PROPER SEATING.

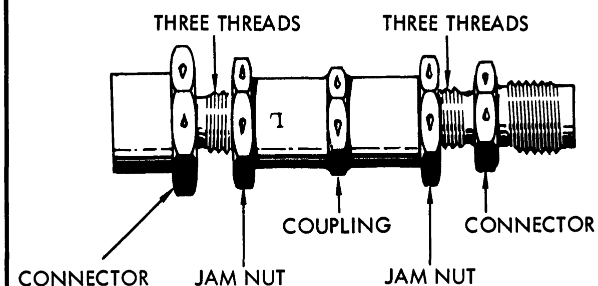


f REMOVE THE CLAMP FROM THE PRELOADER. WITH ALL TENSION OFF THE PRELOADER, LOOSEN THE SHEAVE COVER SCREWS 1/8 INCH, RAISE THE COVER, AND REMOVE THE PRELOADER. LEAVE THE SHEAVE COVER SCREWS FINGERTIGHT.

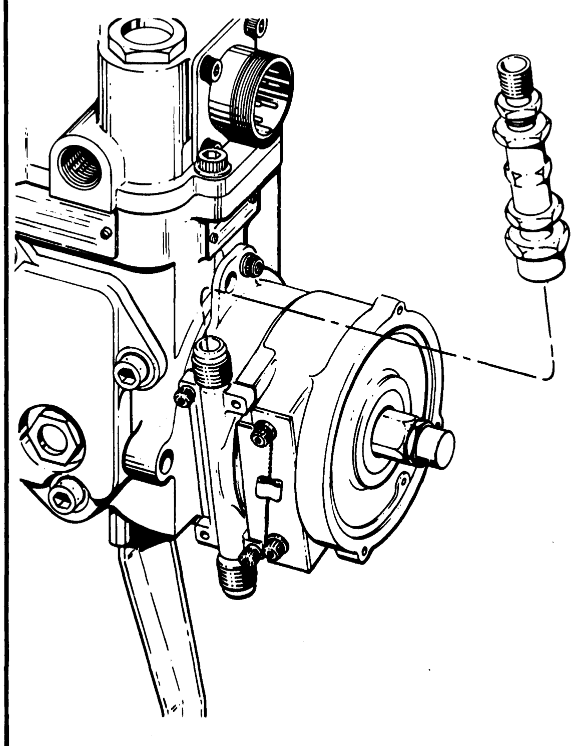
g INSTALL THE PLUG IN THE RIGGING PORT ON THE NOZZLE AREA CONTROL; TIGHTEN FINGERTIGHT.

4 MICRO-ADJUST UNIT

a CENTER THE MICRO-ADJUST UNIT. WITH THE JAM NUTS RUN UP AGAINST THE MICRO-ADJUST COUPLING FINGERTIGHT, THREE THREADS MUST SHOW BETWEEN EACH JAM NUT AND THE CORRESPONDING CONNECTOR HEX.



b INSTALL THE MICRO-ADJUST UNIT ON THE SPRING-BOX SHEAVE COVER; TORQUE THE CONNECTOR TO 60-80 LB-IN.



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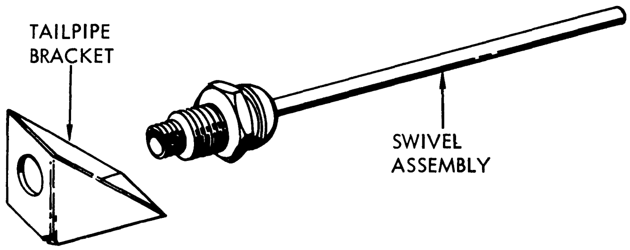
4C-2-8-(33-6)

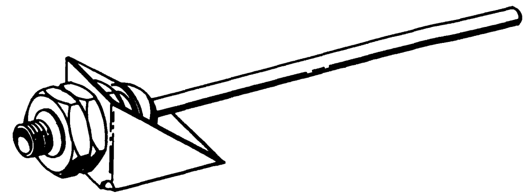
Figure 4-13. Variable Nozzle Feedback Linkage (Sheet 6 of 13)

5 TELESCOPIC UNIT

a REMOVE THE TELESCOPIC UNIT OUTER SLIDER AND PLACE ASIDE. REMOVE THE TWO JAM NUTS FROM THE TELESCOPIC UNIT SWIVEL ASSEMBLY, AND INSERT INTO THE TAILPIPE MOUNTING BRACKET, FROM THE REAR SIDE.

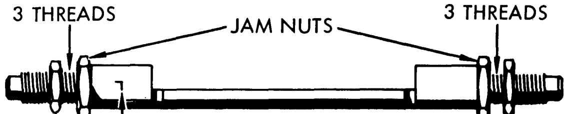


b INSTALL THE TWO JAM NUTS AND TORQUE TO 110-125 LB-IN.



6 CONDUIT

a CENTER THE QUICK-DISCONNECT UNIT. WITH THE JAM NUTS RUN UP AGAINST THE QUICK-DISCONNECT COUPLING FINGERTIGHT, THREE THREADS MUST SHOW BETWEEN EACH JAM NUT AND THE CORRESPONDING CONNECTOR HEX.



b POSITION THE FORWARD CONDUIT INBOARD OF THE AFTERBURNER FUEL TUBES. CONNECT THE CONDUIT TO THE MICRO-ADJUST UNIT ON THE NOZZLE AREA CONTROL. CLAMP THE CONDUIT LOOSELY TO THE MOUNTING BRACKETS.

c CONNECT THE QUICK-DISCONNECT UNIT TO THE REAR END OF THE FORWARD CONDUIT, LEFT HAND THREADS FORWARD.

d POSITION THE REAR CONDUIT OUTBOARD OF THE ACTUATOR HEAD-END SUPPLY MANIFOLD AND INBOARD OF THE ROD-END SUPPLY AND SEAL DRAIN TUBES, WITH THE SHARPLY-BENT END REARWARD. CLAMP THE CONDUIT LOOSELY TO THE HEAD-END SUPPLY MANIFOLD AND THE MOUNTING BRACKETS. CONNECT THE CONDUIT TO THE TELESCOPIC UNIT SWIVEL ASSEMBLY AND THE QUICK-DISCONNECT UNIT.

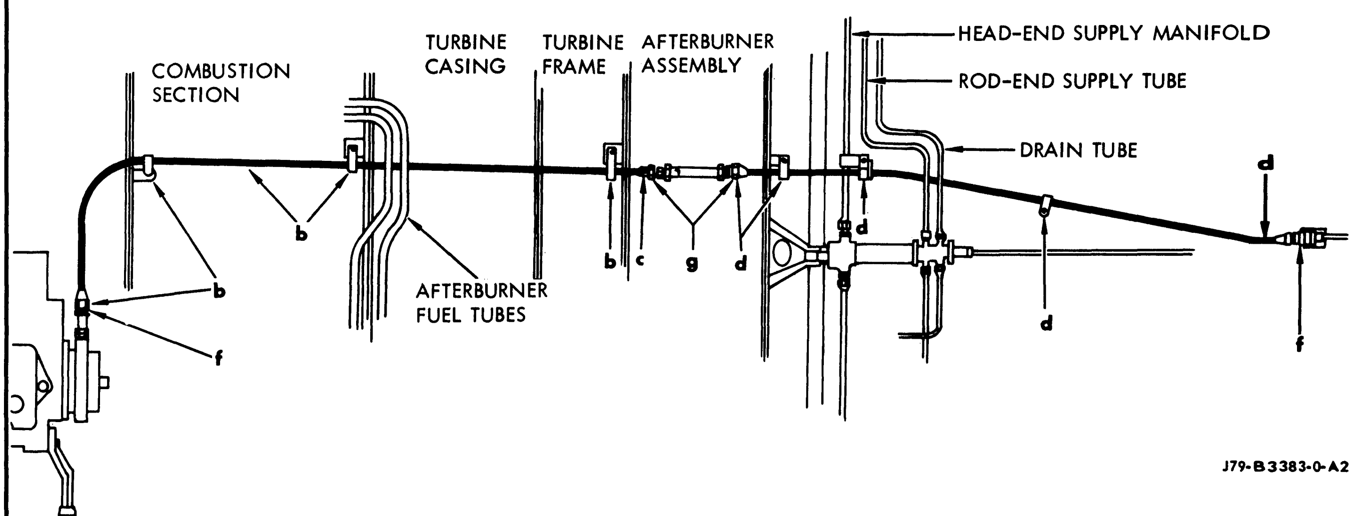
e SHIFT THE POSITION OF BOTH CONDUITS AS NECESSARY TO PREVENT STRESS AND CHAFING.

f TORQUE THE CONDUIT COUPLING NUTS, TO THE MICRO-ADJUST UNIT AND TELESCOPIC UNIT SWIVEL ASSEMBLY, TO 60-80 LB-IN.

CAUTION

IN THE FOLLOWING STEP, DO NOT OVERTORQUE. EXCESSIVE TORQUE CAN CRIMP THE CONNECTORS INTO THE CABLE.

g TORQUE THE CONDUIT COUPLING NUTS, TO THE QUICK-DISCONNECT UNIT CONNECTORS, TO 60 LB-IN



4C-2-8-(33-7)

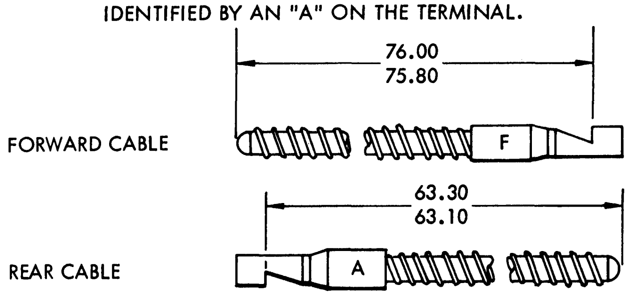
Figure 4-13. Variable Nozzle Feedback Linkage (Sheet 7 of 13)

7 CABLE LUBRICATION

NOTE

IN THE FOLLOWING STEPS, PROPER LUBRICATION OF THE CABLES IS MANDATORY. THE USE OF RUBBER GLOVES IS RECOMMENDED. MOLYKOTE M-77 IS THE PREFERRED LUBRICANT. IF M-77 IS NOT AVAILABLE, ELECTRO-MOLY/40 MAY BE USED. DO NOT DILUTE THE LUBRICANT, BUT MIX THOROUGHLY BEFORE USE.

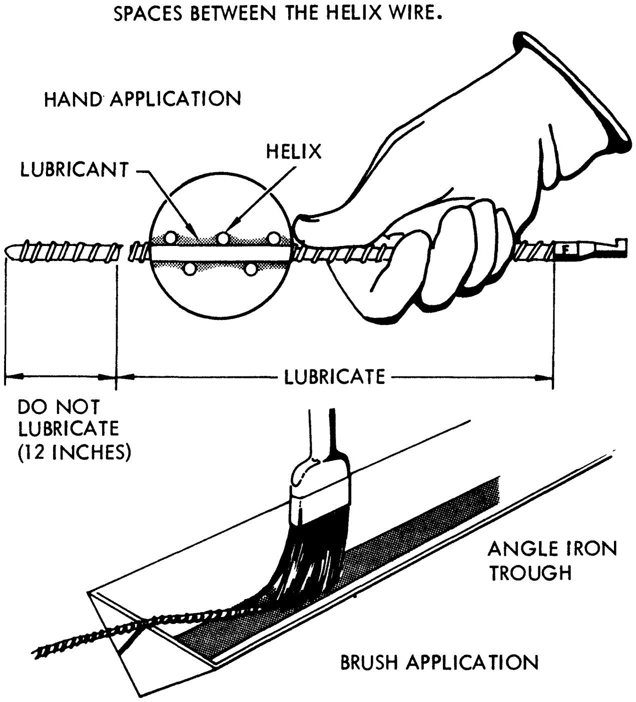
a THE FORWARD AND REAR CABLES ARE DIFFERENT LENGTHS. THE FORWARD CABLE IS IDENTIFIED BY AN "F" ON THE TERMINAL AND THE REAR CABLE IS IDENTIFIED BY AN "A" ON THE TERMINAL.



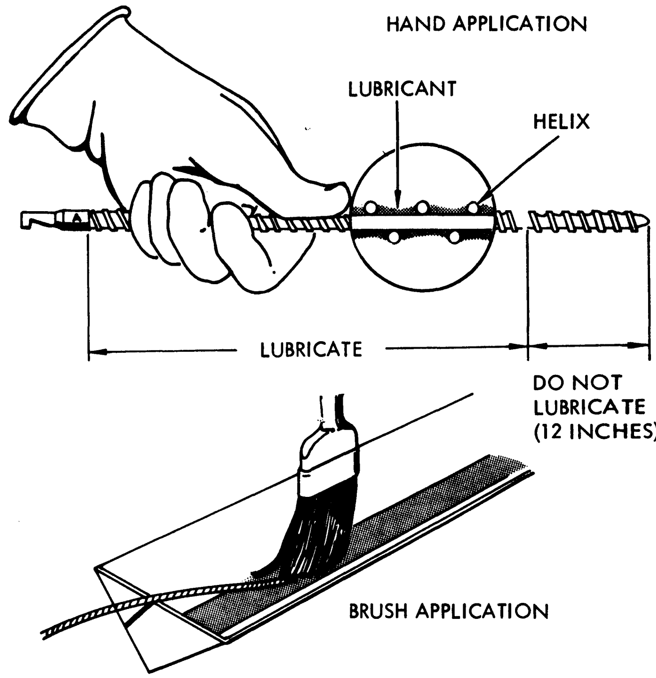
CAUTION

IN THE FOLLOWING STEPS, DO NOT LUBRICATE THE FORWARD 12 INCHES OF THE FORWARD CABLE OR THE REAR 12 INCHES OF THE REAR CABLE.

b APPLY ENOUGH LUBRICANT (1 TO 1.5 OUNCES) TO THE FORWARD CABLE TO COMPLETELY FILL THE SPACES BETWEEN THE HELIX WIRE.



c APPLY ENOUGH LUBRICANT (1 TO 1.5 OUNCES) TO THE REAR CABLE TO COMPLETELY FILL THE SPACES BETWEEN THE HELIX WIRE.



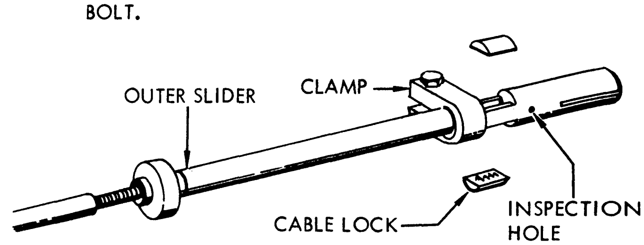
8 CABLE INSTALLATION

a REMOVE THE COVER FROM THE QUICK-DISCONNECT UNIT.

CAUTION

IN THE FOLLOWING STEPS, DO NOT TRY TO INSERT THE CABLE TERMINAL END INTO THE QUICK-DISCONNECT UNIT.

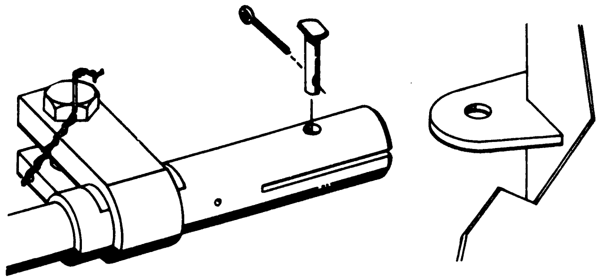
b LOOSEN THE CLAMP ON THE TELESCOPIC UNIT OUTER SLIDER. SLIDE THE CLAMP FORWARD AND REMOVE THE CABLE LOCKS. PLACE THE OUTER SLIDER OVER THE REAR END OF THE INSTALLED CABLE. WHEN THE CABLE CAN BE SEEN IN THE INSPECTION HOLE OF THE SLIDER, PUT THE TWO CABLE LOCKS IN PLACE TO ENGAGE THE CABLE. SLIDE THE CLAMP OVER THE LOCKS; TORQUE THE CLAMP BOLT TO 24-27 LB-IN. AND LOCKWIRE THE BOLT.



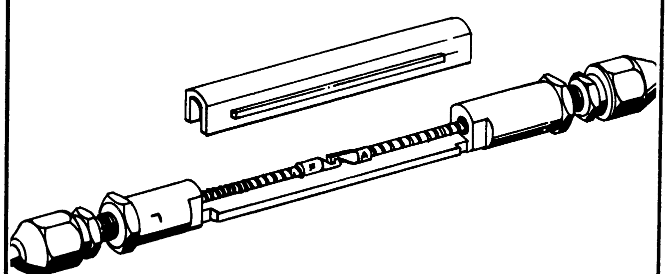
4C-2-8-(33-8)B

Figure 4-13. Variable Nozzle Feedback Linkage (Sheet 8 of 13)

8 c CONNECT THE OUTER SLIDER TO THE EXHAUST NOZZLE BRACKET WITH A MOUNTING PIN AND COTTER PIN. NO WASHER IS REQUIRED. DO NOT BEND THE COTTER PIN AT THIS TIME.

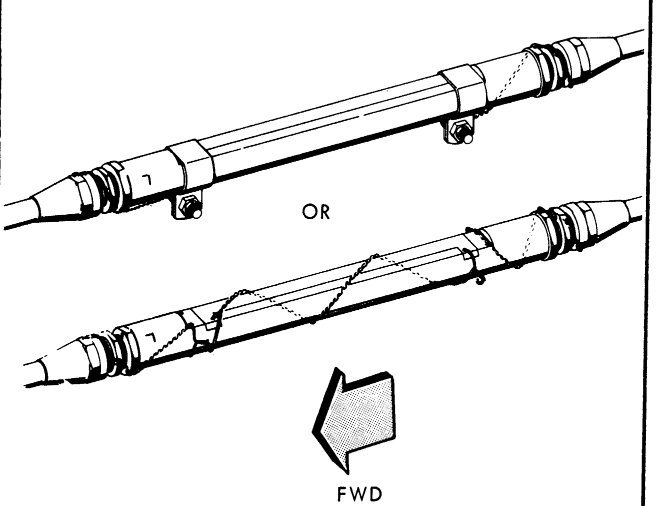


d CONNECT THE FORWARD AND REAR CABLES AT THE QUICK-DISCONNECT UNIT. PLACE THE COVER ON THE QUICK-DISCONNECT UNIT AND SECURE IN PLACE. EITHER LOCKWIRE OR CLAMPS MAY BE USED.

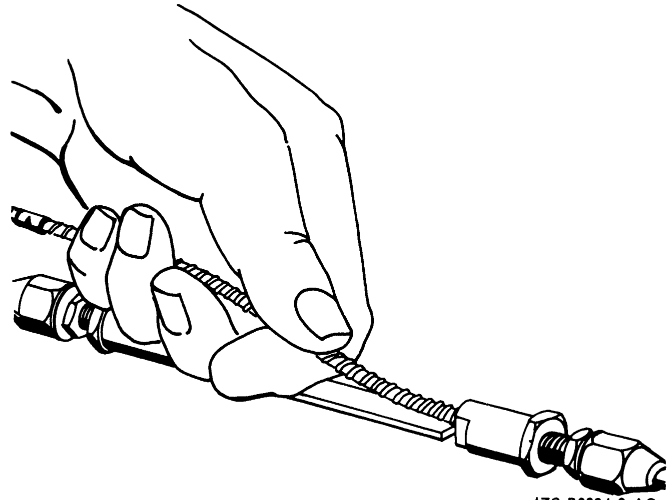


CAUTION

CLAMP BOLT HEADS MUST BE INBOARD AND AT LEAST 1/8 INCH FROM AFTERBURNER SPRAYBAR TUBES TO PREVENT CHAFING.



e INSERT THE REAR CABLE INTO THE CONDUIT AT THE QUICK-DISCONNECT UNIT.



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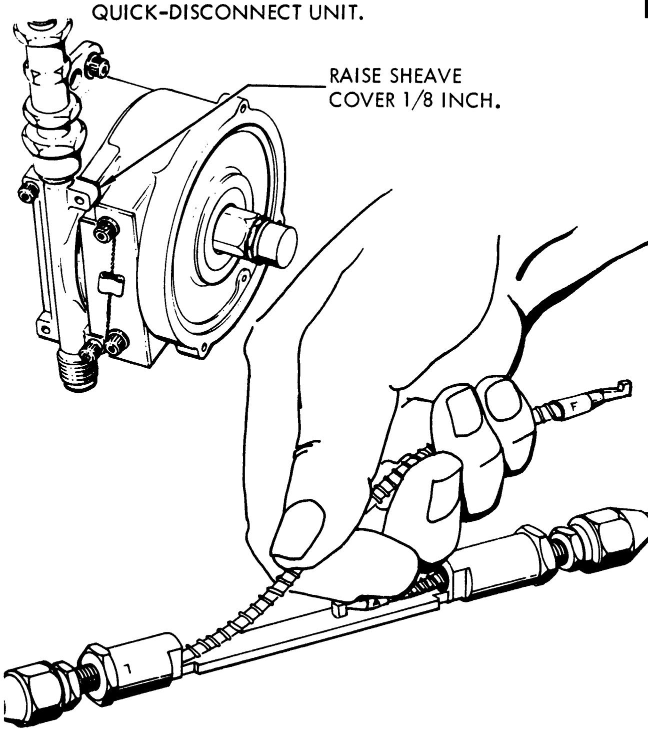
f LOOSEN THE SHEAVE COVER SCREWS ON THE SPRING-BOX AND RAISE THE COVER ABOUT 1/8 INCH. INSERT THE FORWARD CABLE INTO THE CONDUIT AT THE QUICK-DISCONNECT UNIT.



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4C-2-8-(33-9)B

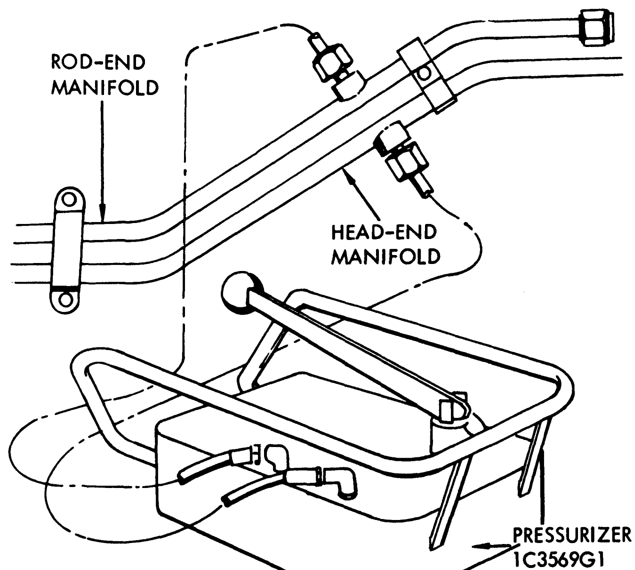
Figure 4-13. Variable Nozzle Feedback Linkage (Sheet 9 of 13)

RIGGING

1 PRESSURIZER CONNECTION

a REMOVE THE PRESSURE CAPS FROM THE NOZZLE ACTUATOR HEAD-END AND ROD-END SUPPLY MANIFOLDS.

b CONNECT NOZZLE ACTUATOR PRESSURIZER, 1C3569-G1, TO THE NOZZLE ACTUATOR SUPPLY MANIFOLDS.

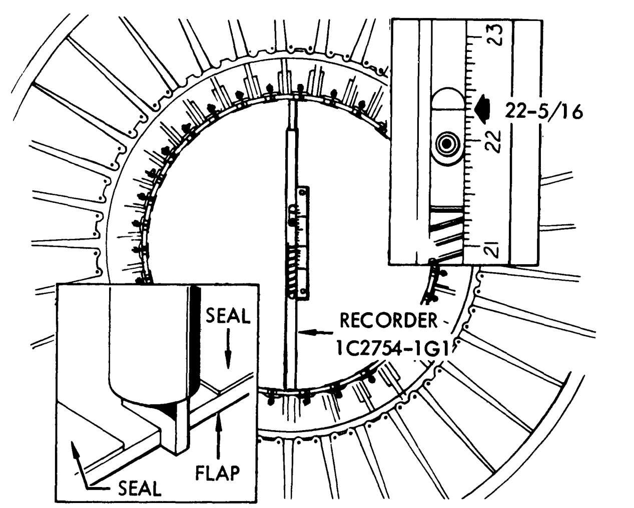


CAUTION

IN THE FOLLOWING STEP, DO NOT PERMIT PRESSURIZER OPERATING PRESSURE TO EXCEED 300 PSI, WHILE ACTUATING THE EXHAUST NOZZLE.

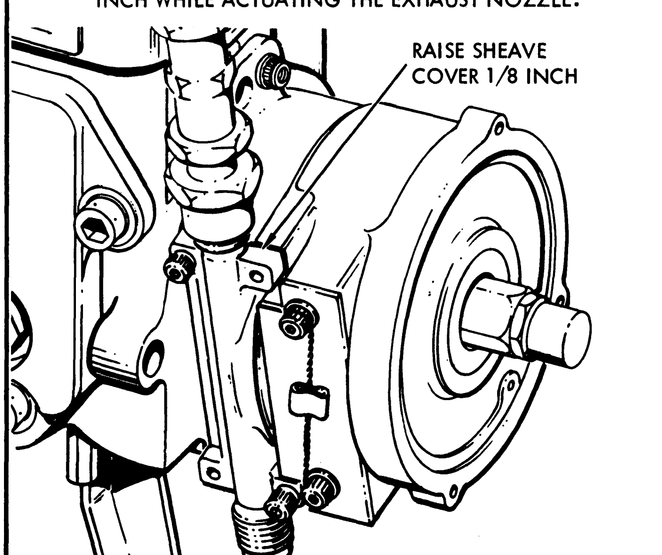
b ACTUATE THE EXHAUST NOZZLE CLOSED TO A PRIMARY FLAP DIAMETER OF 22-5/16 ± 1/16 INCHES.

c USE THE NOZZLE DIAMETER RECORDER, 1C2754-1G1, TO MEASURE; TAKE AN AVERAGE FROM FOUR READINGS AT DIFFERENT LOCATIONS ACROSS THE TRAILING EDGES OF THE PRIMARY FLAPS. BE CAREFUL TO MEASURE AT THE FLAPS, NOT THE SEALS.



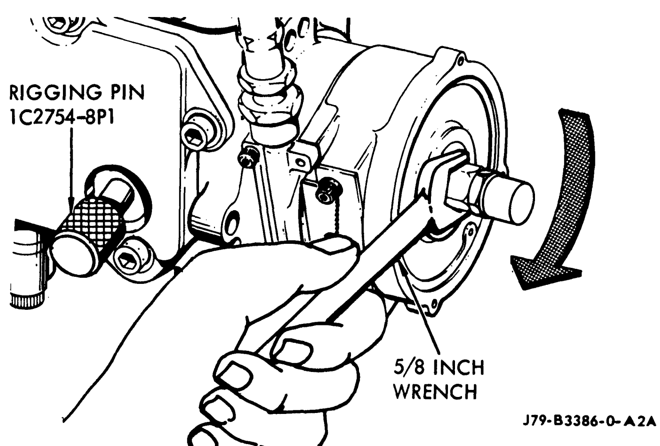
2 NOZZLE POSITIONING

a RAISE THE SPRING BOX SHEAVE COVER AT LEAST 1/8 INCH WHILE ACTUATING THE EXHAUST NOZZLE.



3 CABLE ENGAGEMENT

a REMOVE THE RIGGING PORT PLUG FROM THE NOZZLE AREA CONTROL. RAISE THE SHEAVE COVER ABOUT 1/8 INCH. USE A 5/8 INCH OPEN-END WRENCH, AND ROTATE THE SPRINGBOX ARBOR SHAFT CLOCKWISE UNTIL RIGGING PIN, 1C2754-8P1, CAN BE INSERTED; INSERT THE PIN.



4C-2-8-(33-10)

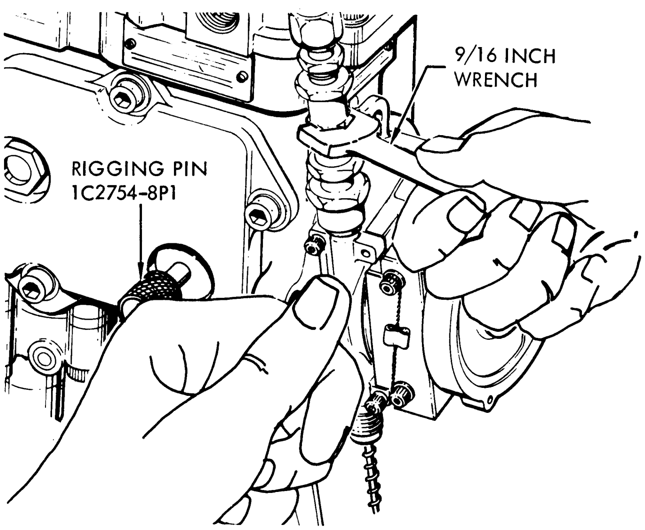
Figure 4-13. Variable Nozzle Feedback Linkage (Sheet 10 of 13)

3

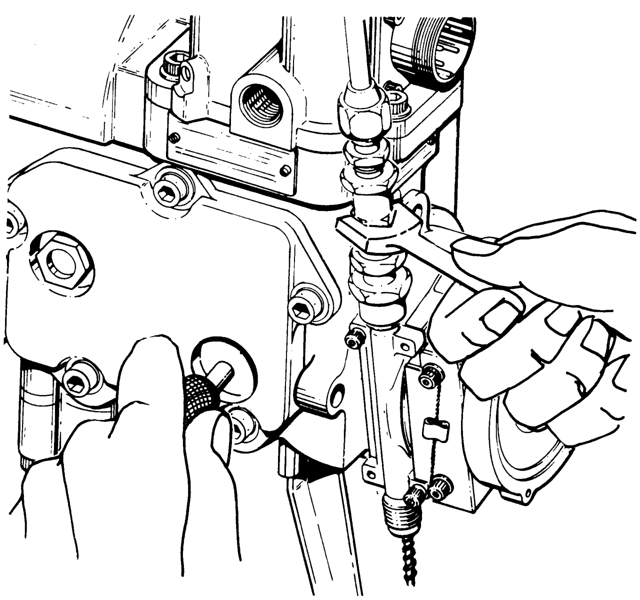
CAUTION

IN THE FOLLOWING STEP, MAKE SURE THE SHEAVE COVER SEATS ON THE SPRINGBOX WITH FINGER PRESSURE ONLY, BEFORE TIGHTENING THE COVER SCREWS.

b SEAT THE SHEAVE COVER ON THE SPRINGBOX, BY HAND PRESSURE ONLY. USE THE MICRO-ADJUST UNIT TO MOVE THE FEEDBACK CABLE UNTIL THE SHEAVE COVER SEATS EASILY IN PLACE. DO NOT FORCE THE COVER DOWN. WHEN THE COVER IS SEATED, TORQUE THE COVER SCREWS TO 13-16 LB-IN.



c USE THE MICRO-ADJUST UNIT AGAIN, THIS TIME TO REMOVE TENSION FROM THE RIGGING PIN. WHEN THE RIGGING PIN IS FREE, REMOVE THE PIN.

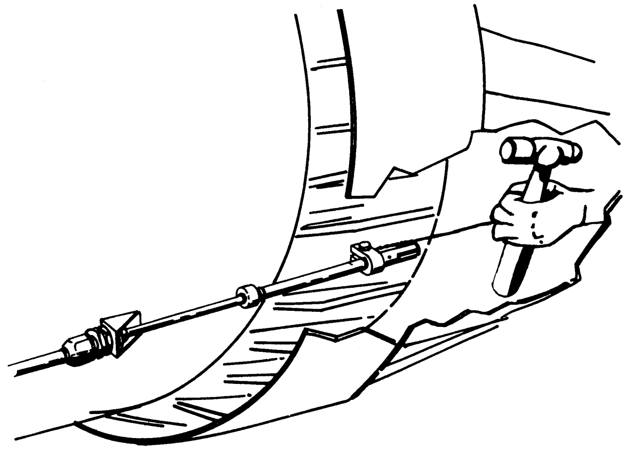


d CONNECT THE OVERTRAVEL TUBE TO THE SPRINGBOX; TORQUE TO 60-80 LB-IN.

4 **INSPECTION FOR CABLE BINDING**

a ACTUATE THE NOZZLE TO THE FULL-OPEN POSITION.

b WRAP A LONG PIECE OF DOUBLED LOCKWIRE AROUND THE CLAMP ON THE TELESCOPIC UNIT OUTER SLIDER, AND RUN THE WIRE BACK THROUGH THE NOZZLE, TYING THE REAR END TO ANY CONVENIENT HANDLE, SUCH AS A HAMMER HANDLE.



c PULL THE LOCKWIRE REARWARD TO PUT TENSION ON THE CABLE, AND DISENGAGE THE OUTER SLIDER BY REMOVING THE COTTER PIN AND MOUNTING PIN AT THE MOUNTING BRACKET. LET THE CABLE RETRACT SLOWLY TO THE NOZZLE AREA CONTROL STOP.

d CYCLE THE CABLE FROM STOP TO STOP SEVERAL TIMES BY PULLING THE LOCKWIRE. THE CABLE MUST NOT BIND, AND THE SPRINGBOX SPRING TENSION MUST RETRACT THE CABLE SMOOTHLY ALL THE WAY TO THE STOP. IF THE CABLE SEEMS TO BIND, OR THE CABLE RETRACTION IS NOT SMOOTH:

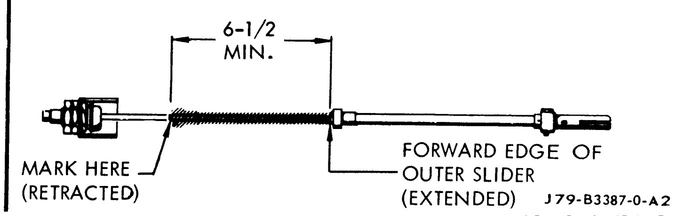
(1) INSPECT THE FORWARD AND REAR CONDUITS FOR DENTS OR BENDS.

(2) REMOVE THE QUICK-DISCONNECT UNIT COVER AND INSPECT FOR DISTORTION.

(3) REMOVE THE TELESCOPIC UNIT OUTER SLIDER; INSPECT THE SLIDER AND SWIVEL ASSEMBLY FOR DISTORTION OR CORROSION.

(4) REMOVE THE FEEDBACK CABLE AND INSPECT FOR WEAR AND PROPER LUBRICATION.

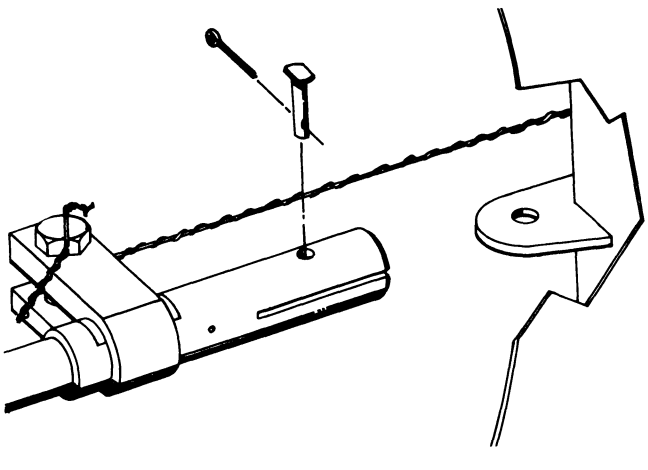
e MARK THE POSITION OF THE FORWARD EDGE OF THE TELESCOPIC UNIT OUTER SLIDER. PULL THE CABLE OUT TO THE STOP, AND MARK THE POSITION OF THE FOR-WARD EDGE AGAIN. MEASURE THE DISTANCE BETWEEN THE TWO MARKS: MEASUREMENT MUST NOT BE LESS THAN 6-1/2 INCHES.



4C-2-8-(33-11)

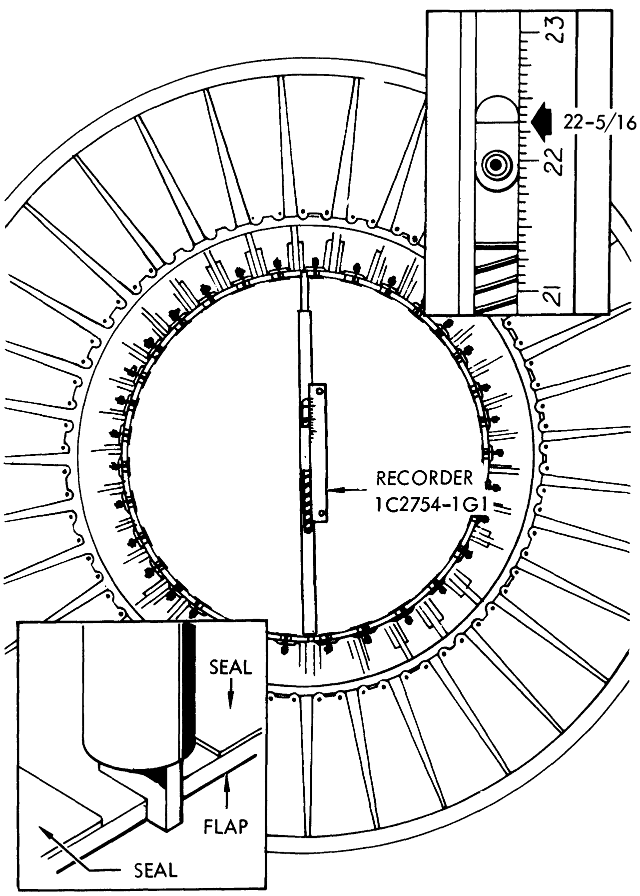
Figure 4-13. Variable Nozzle Feedback Linkage (Sheet 11 of 13)

4 f LUBRICATE THE OUTER SLIDER MOUNTING PIN WITH MOLYKOTE M-77. CONNECT THE OUTER SLIDER TO THE MOUNTING BRACKET. SECURE THE MOUNTING PIN WITH A COTTER PIN; BEND THE COTTER PIN. REMOVE THE LOCKWIRE USED TO CYCLE THE CABLE.

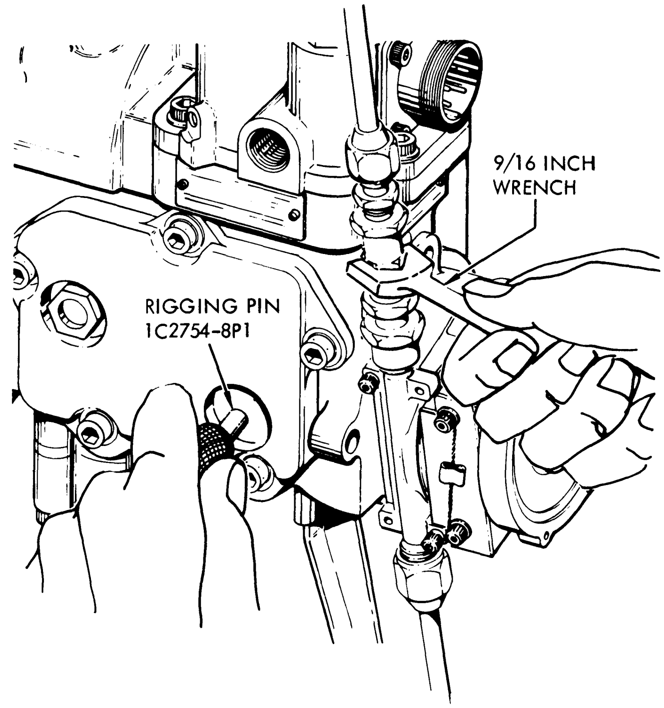


5 RIGGING CHECK

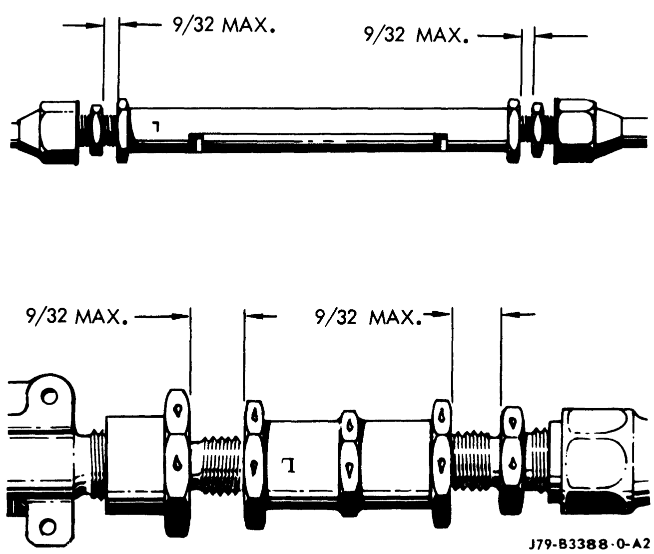
a ACTUATE THE NOZZLE TO THE RIGGING DIAMETER OF 22-5/16± 1/16 INCHES (AVERAGE OF 4 READINGS).



b TRY THE RIGGING PIN IN THE NOZZLE AREA CONTROL. ADJUST THE LINKAGE WITH THE MICRO-ADJUST UNIT, IF NECESSARY, UNTIL THE RIGGING PIN SLIDES FREELY INTO THE CAM SLOT. REMOVE THE RIGGING PIN.



c TORQUE THE JAM NUTS OF THE MICRO-ADJUST AND QUICK-DISCONNECT UNITS TO 50-60 LB-IN. DO NOT ALLOW EITHER COUPLING TO ROTATE WHILE TORQUING THE JAM NUTS. MEASURE THE DISTANCE BETWEEN EACH JAM NUT AND THE CORRESPONDING CONNECTOR HEX. IF THE MEASUREMENT EXCEEDS 9/32 INCH, POSITIVE ENGAGEMENT IS NOT CORRECT; RE-RIG THE SYSTEM.



4C-2-8—(33-12)

Figure 4-13. Variable Nozzle Feedback Linkage (Sheet 12 of 13)

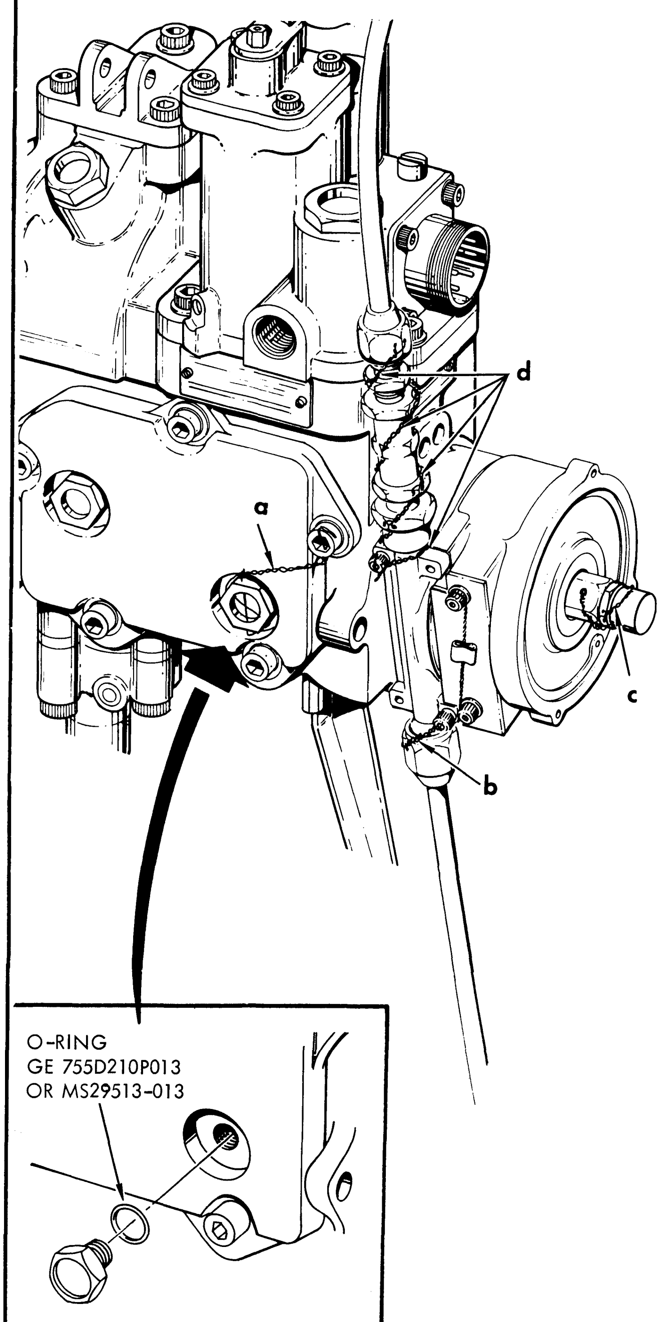
6 SECURING THE SYSTEM

a PLACE A NEW O-RING (GE 755D210P013) ON THE RIGGING PORT PLUG AND INSTALL IN THE NOZZLE AREA CONTROL; TORQUE TO 20-30 LB-IN. AND LOCKWIRE.

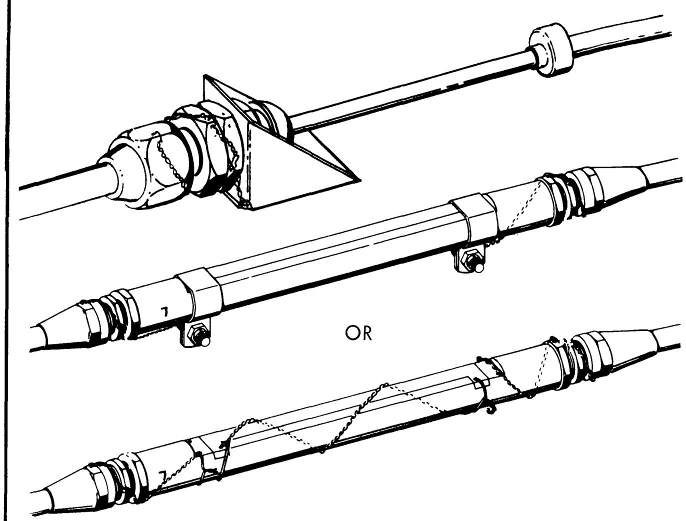
b LOCKWIRE THE OVERTRAVEL TUBE COUPLING NUT TO A SHEAVE COVER SCREW.

c LOCKWIRE THE CAP NUT TO THE ARBOR SHAFT ON THE SPRINGBOX.

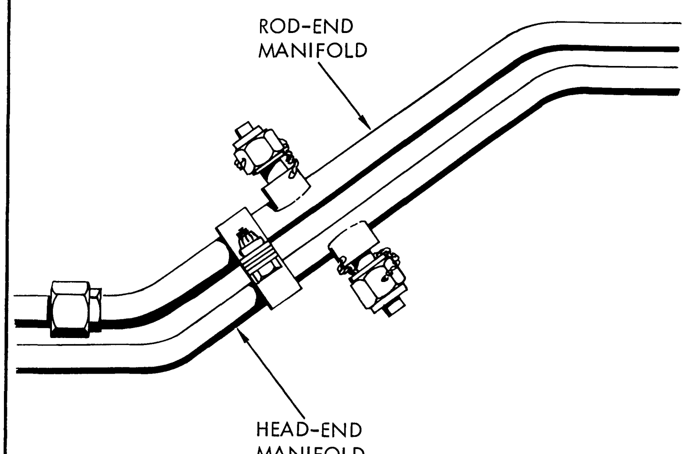
d LOCKWIRE THE CONDUIT COUPLING NUT TO THE MICRO-ADJUST UNIT AND TO A SHEAVE COVER SCREW.



e LOCKWIRE THE CONDUIT COUPLING NUTS TO THE JAM NUTS ON THE TELESCOPIC UNIT SWIVEL ASSEMBLY AND TO THE QUICK-DISCONNECT UNIT.



f ACTUATE THE EXHAUST NOZZLE TO THE FULL-OPEN POSITION, AND DISCONNECT THE PRESSURIZER. INSTALL THE PRESSURE CAPS ON THE NOZZLE ACTUATOR HEAD-END AND ROD-END SUPPLY MANIFOLDS; TORQUE TO 270-300 LB-IN. AND LOCKWIRE



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4C-2-8-(33-13)

Figure 4-13. Variable Nozzle Feedback Linkage (Sheet 13 of 13)

4-103. **NOZZLE AREA CONTROL TO NOZZLE PUMP LINKAGE.**

4-104. **Tools and Equipment.**

Set, rigging

4-105. **Removal.** See figure 4-14

4-106. **Installation.** See figure 4-14.

4-107. **Rigging.** See figure 4-14.

4-108. **FLEXIBLE CABLE ENGINE THROTTLE INPUT LINKAGE.** See figures 4-15 and 4-16.

4-109. **Tools and Equipment.**

Set, rigging

4-110. **Materials.**

Lockwire, MS20995NC32

4-111. **Manpower Requirements.**

a. Two men required.

4-112. **Removal.**

a. Open doors 81R, 82L and 83 L or R.

b. Remove torque booster.

4-113. **Lubrication.** Lubricate flexible cable per paragraph 4-147 and figures 4-15 and 4-16.

4-114. **Installation and Rigging.**

a. Check that following have been accomplished:

(1) Torque booster has been removed.

(2) *Linkage cable boxes and conduit assemblies have been installed and torqued.*

(3) Overtravel tube has been removed from afterburner fuel control cable box.

(4) Main fuel control, afterburner fuel control, and nozzle area control throttle input shaft nuts have been removed, new tab washers installed and nuts turned back onto shaft. Shafts should then be pushed into controls.

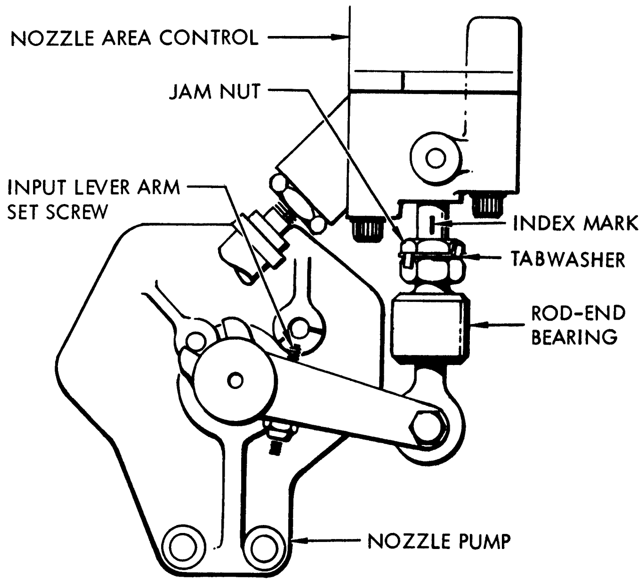
b. *Rig throttle input linkage.*

c. Install overtravel tube.

d. Install torque booster. Refer to paragraph 4-57.

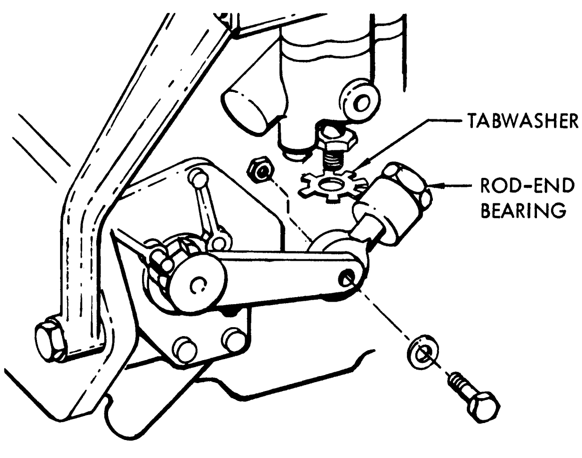
e. *Close doors 81R, 82L and 83 L or R.*

f. *Perform engine checkout. Refer to paragraph 2-54.*



1 REMOVAL

a STRAIGHTEN THE LOCKING TABS ON THE TABWASHER, LOOSEN THE JAM NUT AND REMOVE THE ROD-END BEARING FROM THE NOZZLE AREA CONTROL OUTPUT SHAFT. DISCARD THE TABWASHER.



b SEPARATE THE ROD-END BEARING FROM THE INPUT LEVER ON THE NOZZLE HYDRAULIC PUMP BY REMOVING THE BOLT, WASHER AND NUT.

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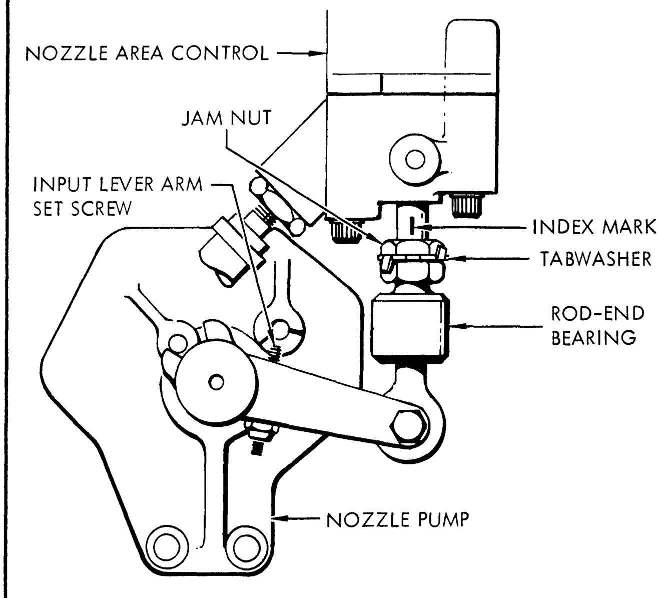
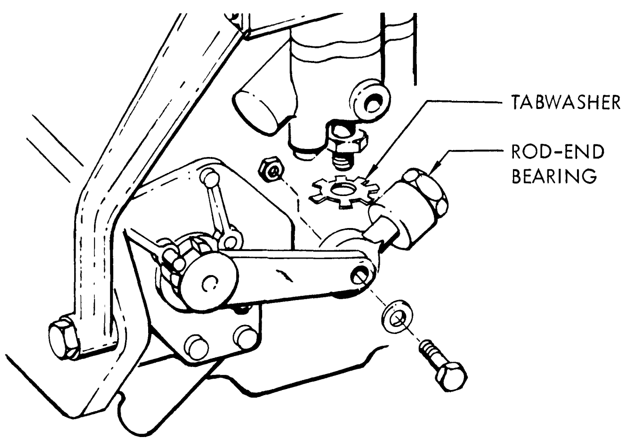
4C-2-8-(32-1)

Figure 4-14. Nozzle Area Control to Nozzle Pump Linkage (Sheet 1 of 2)



1 INSTALLATION

a PLACE A WASHER ON THE CONNECTING BOLT AND CONNECT THE NOZZLE AREA CONTROL ROD-END BEARING TO THE NOZZLE HYDRAULIC PUMP LEVER ARM. THE BEARING MUST BE ON THE INBOARD SIDE OF THE ARM; THE BOLT HEAD MUST BE OUTBOARD.



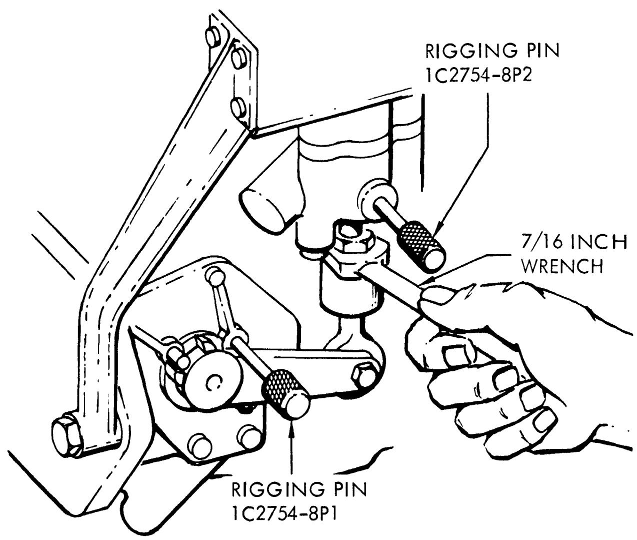
b MOVE THE PUMP LEVER ARM FROM STOP TO STOP AND INSPECT FOR CLEARANCE BETWEEN THE END OF THE BOLT AND THE PUMP HOUSING. MINIMUM CLEARANCE IS 0.010 INCH. ADD WASHERS UNDER THE BOLT HEAD, IF NECESSARY, TO GET THIS CLEARANCE. TORQUE THE BOLT TO 24-27 IN-LB.

c PLACE A NEW TABWASHER ON THE CONTROL OUTPUT SHAFT AND THREAD THE BEARING ON THE SHAFT, SEVERAL TURNS.

2 RIGGING

a LINE UP THE INDEX MARK ON THE CONTROL OUTPUT SHAFT WITH THE RIGGING PIN ACCESS HOLE IN THE NOZZLE AREA CONTROL. INSERT RIGGING PIN, 1C2754-8P2, THROUGH THE SHAFT.

b INSERT RIGGING PIN, 1C2754-8P1, IN THE RIGGING PORT ON THE NOZZLE HYDRAULIC PUMP. THREAD THE ROD-END BEARING ONTO THE OUTPUT SHAFT OF THE NOZZLE AREA CONTROL UNTIL THE SET SCREW ON THE PUMP LEVER ARM **JUST TOUCHES** THE PUMP RIGGING PIN. PULL THE PIN OUT AND PUSH THE PIN IN; THERE MUST BE A SLIGHT DRAG AGAINST THE SET SCREW. USE A LIGHT BEHIND THE RIGGING PIN TO BE SURE OF CONTACT.



c REMOVE THE RIGGING PINS.

3 SECURING THE SYSTEM

HOLD THE ROD-END BEARING HEX WITH A 7/16 INCH WRENCH AND TORQUE THE OUTPUT SHAFT JAM NUT TO 10-15 IN-LB. CHECK THAT THE TORQUE HAS NOT AFFECTED THE RIGGING POSITION.

b BEND A TAB ON THE TABWASHER AGAINST A JAM NUT FLAT; BEND ANOTHER TAB AGAINST THE ROD-END BEARING HEX FLAT.

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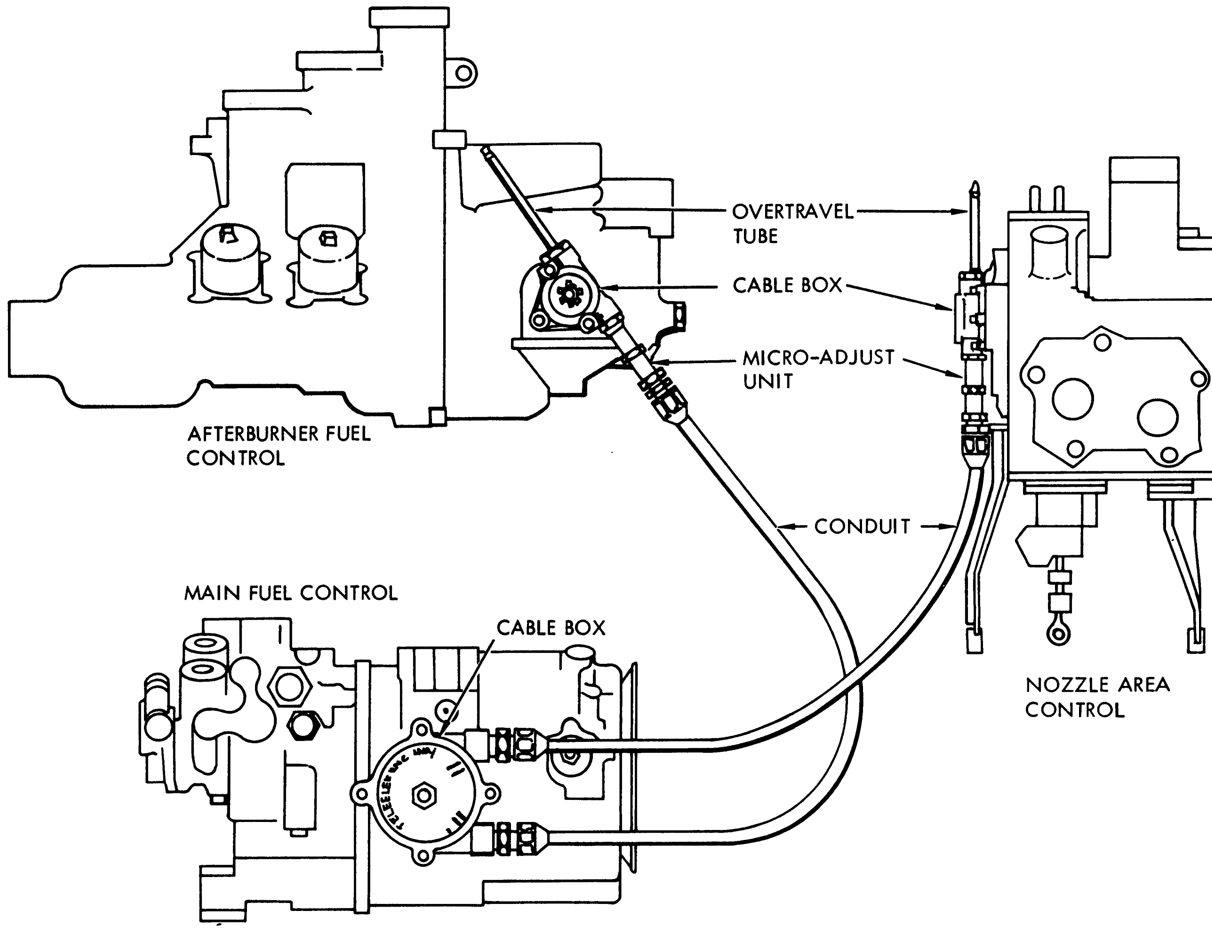
4C-2-8-(32-2)

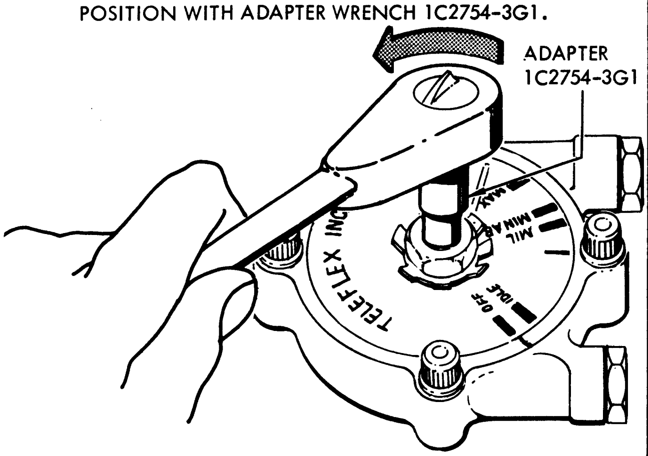
Figure 4-14. Nozzle Area Control to Nozzle Pump Linkage (Sheet 2 of 2)



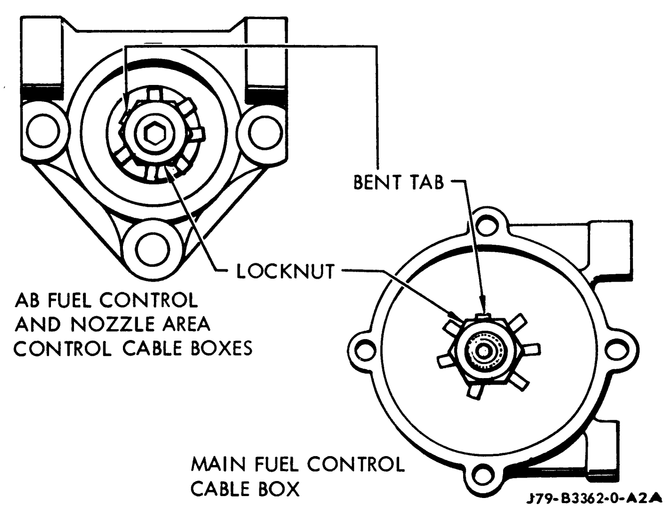
REMOVAL

1 CLUTCH DISENGAGEMENT

a ROTATE THE THROTTLE INPUT SHAFT ON THE MAIN FUEL CONTROL COUNTERCLOCKWISE TO THE **OFF** POSITION WITH ADAPTER WRENCH 1C2754-3G1.



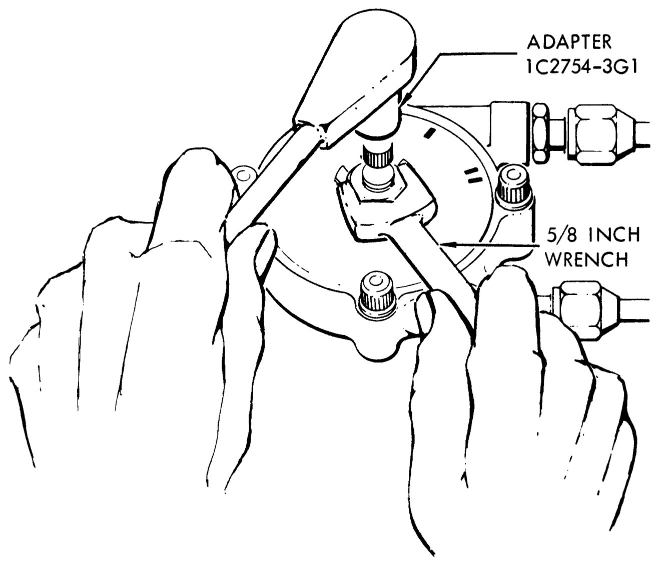
b STRAIGHTEN THE BENT TAB ON THE TABWASHER UNDER THE LOCKNUTS ON THE THROTTLE INPUT SHAFTS OF THE AFTERBURNER FUEL, MAIN FUEL AND NOZZLE AREA CONTROLS.



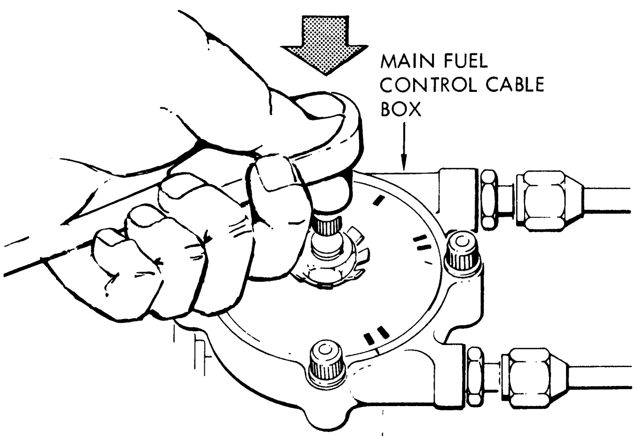
4C-2-8-(29-1)

Figure 4-15. Throttle Input Linkage - BEFORE T.O. 2J-J79-1217 (Sheet 1 of 13)

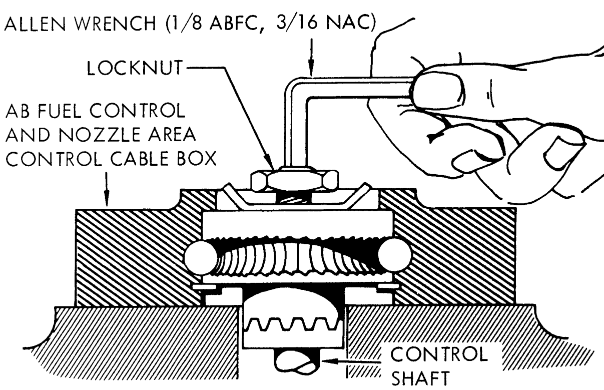
1 c HOLD THE INPUT SHAFT OF THE MAIN FUEL CONTROL WITH THE ADAPTER WRENCH AND LOOSEN THE LOCK-NUT 1-1/2 TURNS WITH A 5/8 INCH WRENCH.



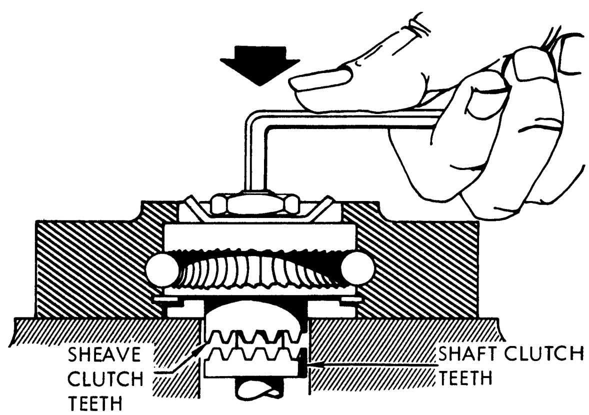
d PUSH THE SHAFT INWARD WITH THE WRENCH TO DIS-ENGAGE THE SHAFT CLUTCH TEETH FROM THE CABLE BOX SHEAVE CLUTCH TEETH.



e HOLD THE INPUT SHAFTS OF THE AFTERBURNER FUEL AND NOZZLE AREA CONTROLS WITH AN ALLEN WRENCH AND LOOSEN EACH LOCKNUT AT LEAST 1-1/2 TURNS WITH A 9/16 INCH WRENCH.

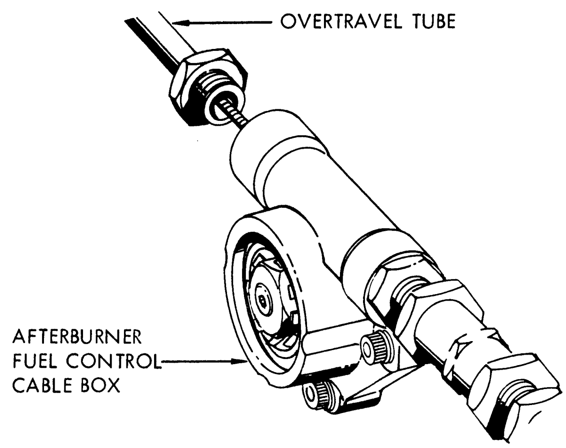


f PUSH EACH SHAFT INWARD WITH THE ALLEN WRENCH TO DISENGAGE THE SHAFT CLUTCH TEETH FROM THE CABLE BOX SHEAVE CLUTCH TEETH.

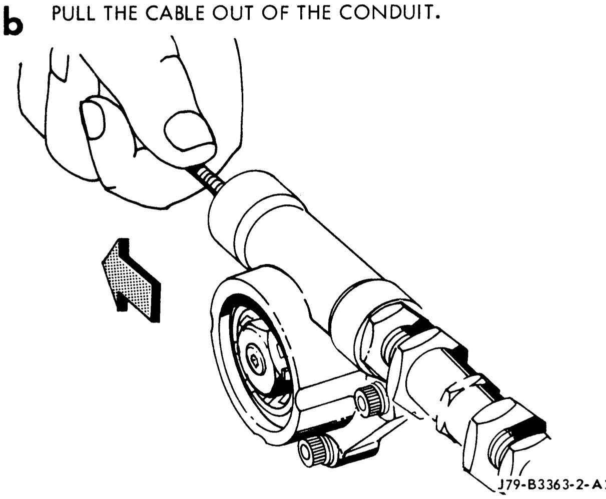


2 CABLE RELEASE

a REMOVE THE OVERTRAVEL TUBE FROM THE AFTER-BURNER FUEL CONTROL CABLE BOX.



b PULL THE CABLE OUT OF THE CONDUIT.



4C-2-8-(29-2)

Figure 4-15. Throttle Input Linkage - BEFORE T.O. 2J-J79-1217 (Sheet 2 of 13)

3 COMPLETE DISASSEMBLY

a DISCONNECT THE TWO CONDUITS AT THE MICRO-ADJUST UNITS AND AT THE MAIN FUEL CONTROL CABLE BOX. REMOVE THE OVERTRAVEL TUBE FROM THE NOZZLE AREA CONTROL CABLE BOX.

b DISCONNECT THE MICRO-ADJUST UNITS AT THE CABLE BOXES ON THE AFTERBURNER FUEL AND NOZZLE AREA CONTROLS. REMOVE THE ADAPTERS FROM THE CABLE BOX ON THE MAIN FUEL CONTROL.

NOTE

IN THE FOLLOWING STEP, IF A CABLE BOX IS DIFFICULT TO REMOVE, DO NOT USE FORCE (WHICH MAY CAUSE INTERNAL DAMAGE TO THE CONTROL); RETURN THE CONTROL, WITH THE CABLE BOX ATTACHED, TO OVERHAUL.

c REMOVE THE LOCKNUT AND TABWASHER FROM EACH CONTROL INPUT SHAFT; REMOVE THE MOUNTING BOLTS AND WASHERS FROM EACH CABLE BOX. REMOVE THE BOXES. DISCARD THE TABWASHERS.

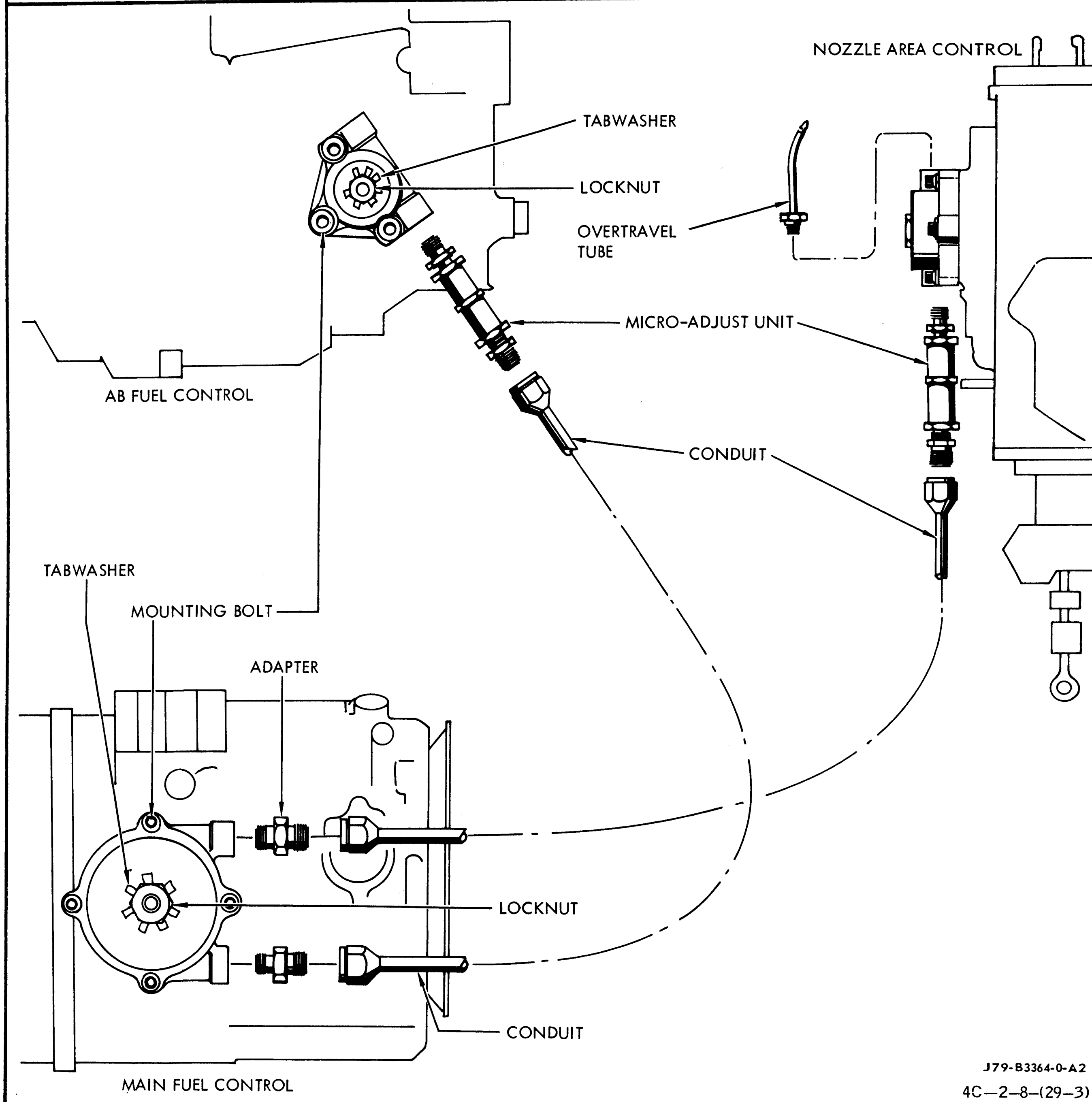


Figure 4-15. Throttle Input Linkage - BEFORE T.O. 2J-J79-1217 (Sheet 3 of 13)

INSTALLATION

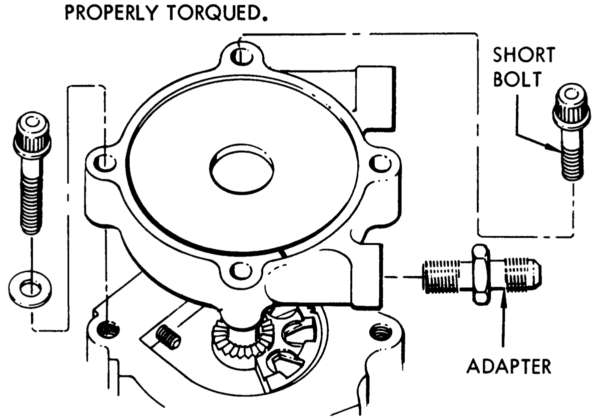
1 CABLE BOX AND ADAPTERS

NOTE

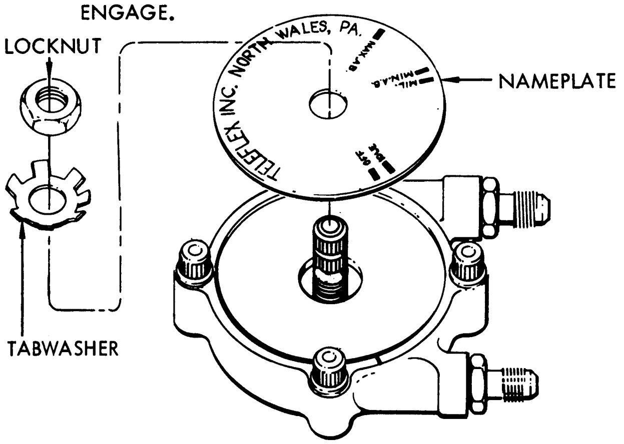
IN THE FOLLOWING STEP, ONLY THE SHORT BOLT WILL BE PERMANENTLY INSTALLED. THE THREE REMAINING ARE SLAVE BOLTS, IN PLACE TO MAKE RIGGING POSSIBLE.

a PLACE THE CABLE BOX IN POSITION ON THE MAIN FUEL CONTROL AND SECURE WITH FOUR BOLTS AND THREE WASHERS. INSTALL THE SHORT BOLT, WITHOUT A WASHER, THROUGH THE UPPER MOUNTING HOLE NEAREST THE COMPRESSOR CASING. TORQUE THE BOLTS TO 24-27 LB-IN. LOCKWIRE THE SHORT BOLT TO THE COMPRESSOR DISCHARGE PRESSURE TUBE COUPLING NUT ON THE CONTROL.

b INSTALL THE TWO ADAPTERS ON THE MAIN FUEL CONTROL CABLE BOX; TORQUE THE ADAPTERS TO 50-60 LB-IN. A GAP OF 5/64 INCH MAX BETWEEN THE ADAPTER HEX AND THE CABLE BOX IS PERMISSIBLE IF PROPERLY TORQUED.



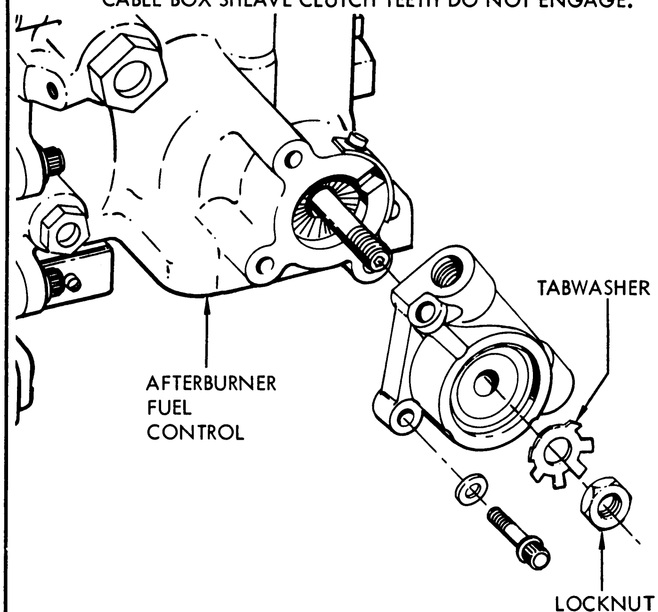
c INSTALL THE NAMEPLATE, LOCKNUT, AND A NEW TABWASHER ON THE INPUT SHAFT. MAKE SURE THAT THE LOCKNUT IS LOOSENED AT LEAST 1-1/2 TURNS AND THAT THE SHAFT IS PUSHED INWARD SO THAT THE SHAFT AND CABLE BOX SHEAVE CLUTCH TEETH DO NOT ENGAGE.

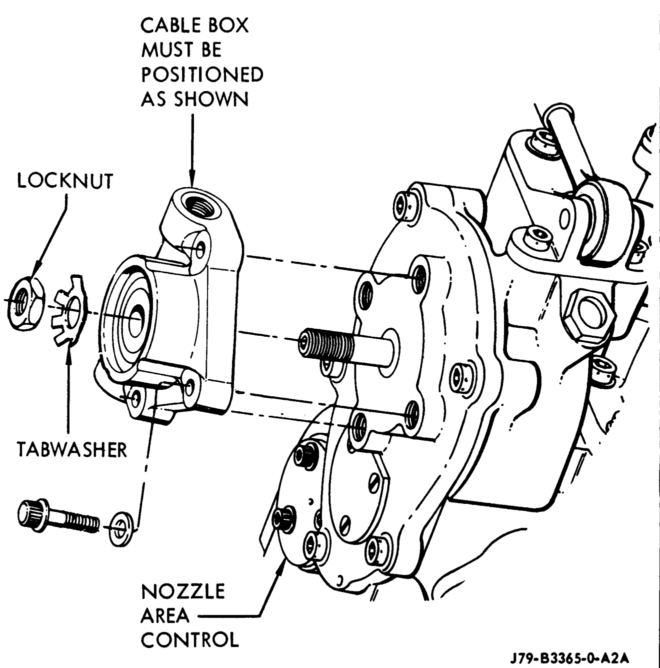


2 CABLE BOXES

a INSTALL THE CABLE BOXES ON THE AFTERBURNER FUEL AND NOZZLE AREA CONTROLS, USING THREE BOLTS AND WASHERS FOR EACH BOX; TIGHTEN FINGERTIGHT.

b INSTALL A NEW TABWASHER AND LOCKNUT ON EACH INPUT SHAFT. MAKE SURE THAT THE LOCKNUTS ARE LOOSENED AT LEAST 1-1/2 TURNS AND THAT THE SHAFTS ARE PUSHED INWARD SO THAT THE SHAFT AND CABLE BOX SHEAVE CLUTCH TEETH DO NOT ENGAGE.



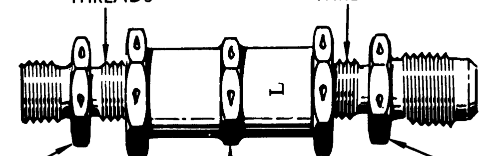


4C-2-8-(29-4)

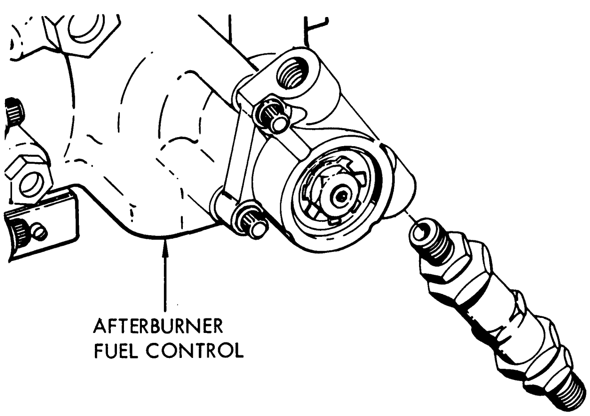
Figure 4-15. Throttle Input Linkage - BEFORE T.O. 2J-J79-1217 (Sheet 4 of 13)

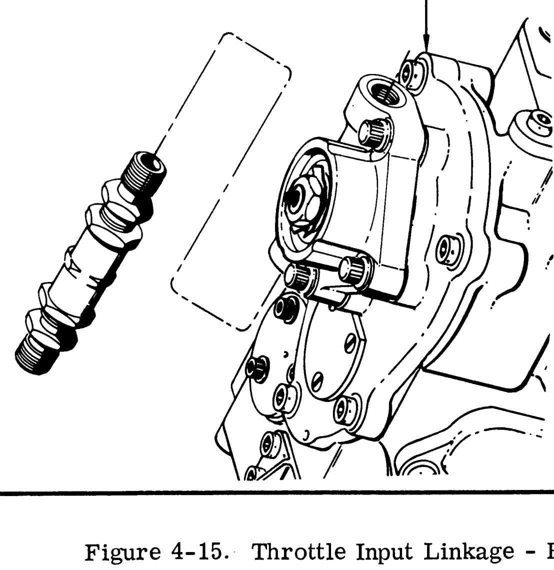
3 MICRO-ADJUST UNITS

a CENTER THE MICRO-ADJUST UNITS. WITH THE JAM NUTS RUN UP AGAINST THE MICRO-ADJUST COUPLING FINGERTIGHT, THREE THREADS MUST SHOW BETWEEN EACH JAM NUT AND THE CORRESPONDING CONNECTOR HEX.



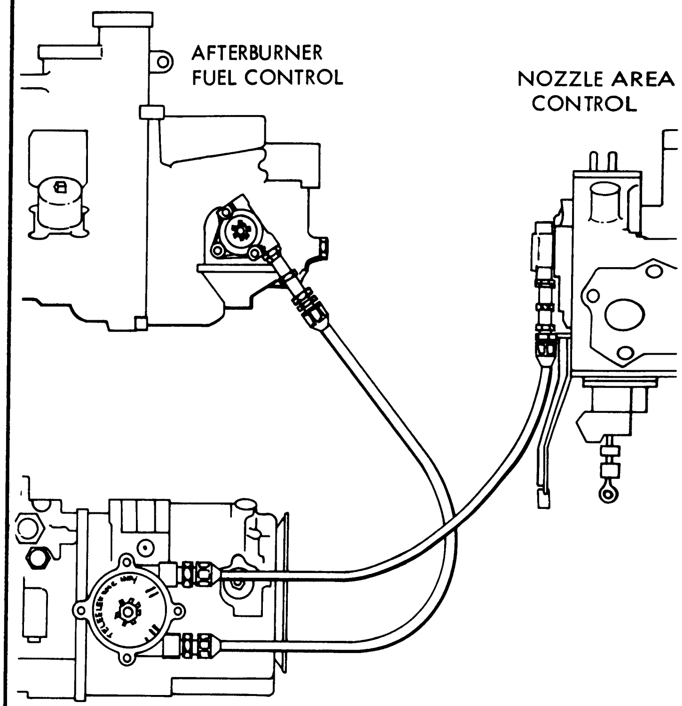
b THREAD THE MICRO-ADJUST UNITS INTO THE CABLE BOXES ON THE AFTERBURNER FUEL AND NOZZLE AREA CONTROLS; TORQUE THE CONNECTORS TO 50-60 LB-IN. A GAP OF 5/64 INCH MAX BETWEEN THE CONNECTOR HEX AND THE CABLE BOX IS PERMISSIBLE IF PROPERLY TORQUED.





4 CONDUIT

a CONNECT THE TWO CONDUITS TO THE MAIN FUEL CONTROL CABLE BOX ADAPTERS; CONNECT THE OTHER ENDS TO THE MICRO-ADJUST UNITS ON THE AFTERBURNER FUEL AND NOZZLE AREA CONTROL CABLE BOXES. IF NECESSARY, THE CABLE BOX MOUNTING BOLTS MAY BE REMOVED TO INSTALL THE CONDUITS.



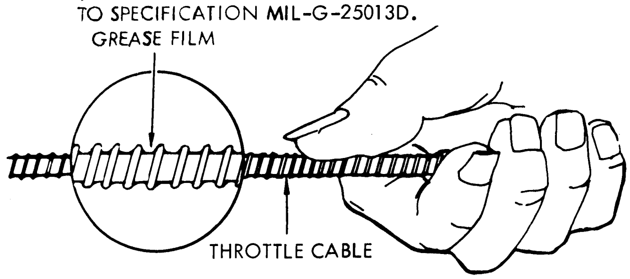
b POSITION THE CONDUITS TO PROVIDE THE LEAST AMOUNT OF STRESS ON THE PARTS. TORQUE THE THREE MOUNTING BOLTS ON EACH CABLE BOX TO 24-27 LB-IN. TORQUE ALL CONDUIT COUPLING NUTS TO 60-80 LB-IN.

J79-B3366-0-A2
4C-2-8-(29-5)

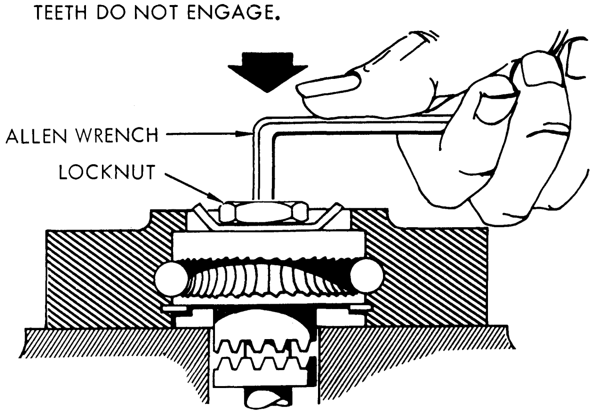
Figure 4-15. Throttle Input Linkage - BEFORE T.O. 2J-J79-1217 (Sheet 5 of 13)

5 CABLE INSTALLATION

a LUBRICATE THE CABLE LIGHTLY WITH SILICONE GREASE (DOW-CORNING 33, LIGHT) OR GREASE CONFORMING TO SPECIFICATION MIL-G-25013D.



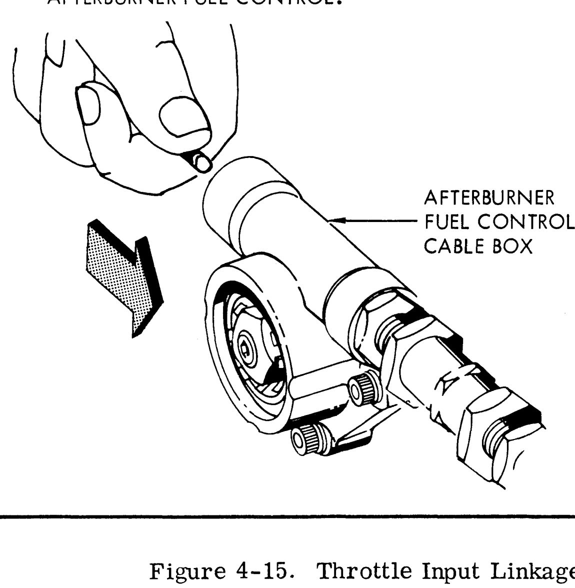
b MAKE SURE THAT EACH CONTROL INPUT SHAFT LOCKNUT IS LOOSENED AT LEAST 1-1/2 TURNS AND THAT THE SHAFT OF EACH CONTROL IS PUSHED INWARD SO THAT THE SHAFT AND CABLE BOX SHEAVE CLUTCH TEETH DO NOT ENGAGE.



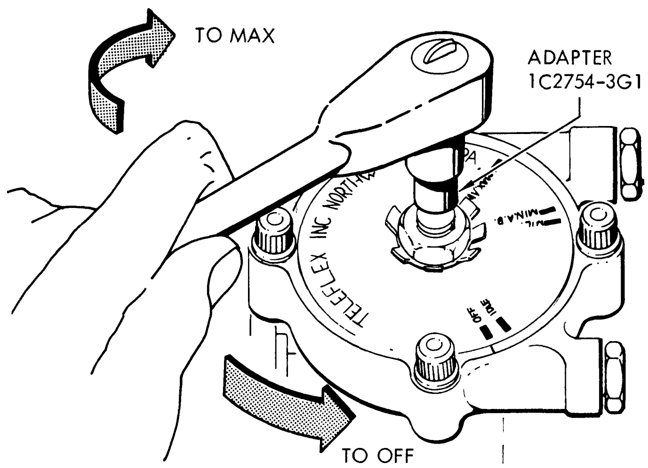
NOTE

IN THE FOLLOWING STEP, THERE MAY BE SOME DIFFICULTY IN GETTING THE CABLE THROUGH THE CABLE BOX ON THE MAIN FUEL CONTROL BECAUSE OF THE SHARP BEND REQUIRED WHEN THE CABLE REVERSES DIRECTION.

c INSERT THE CABLE INTO THE CABLE BOX ON THE AFTERBURNER FUEL CONTROL.



d IF NECESSARY TO ASSIST THE CABLE THROUGH THE MAIN FUEL CONTROL CABLE BOX, INSTALL THE THROTTLE SHAFT ADAPTER WRENCH, 1C2754-3G1, ON THE MAIN FUEL CONTROL THROTTLE SHAFT; ROTATE THE SHAFT TO **OFF**, PULL THE SHAFT OUTWARD, TIGHTEN THE SHAFT LOCKNUT AND ROTATE THE SHAFT TO **MAX**, LOOSEN THE LOCKNUT AND PUSH THE SHAFT INWARD; ROTATE THE SHAFT TO **OFF**. REPEAT AS NECESSARY.



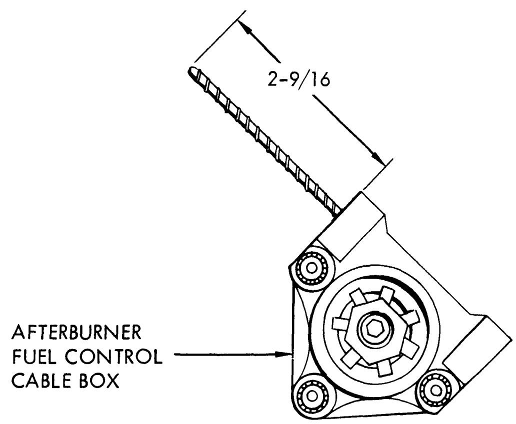
J79-B3367-2-A2
4C-2-8-(29-6)

Figure 4-15. Throttle Input Linkage - BEFORE T.O. 2J-J79-1217 (Sheet 6 of 13)

RIGGING

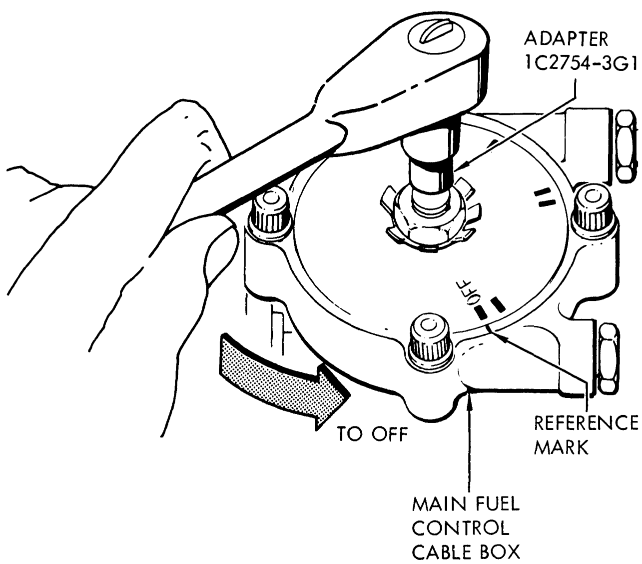
1 CABLE POSITION

POSITION THE CABLE SO THAT 2-9/16 INCHES EXTEND FROM THE CABLE BOX ON THE AFTERBURNER FUEL CONTROL.



2 MAIN FUEL CONTROL SHAFT CLUTCH ENGAGEMENT

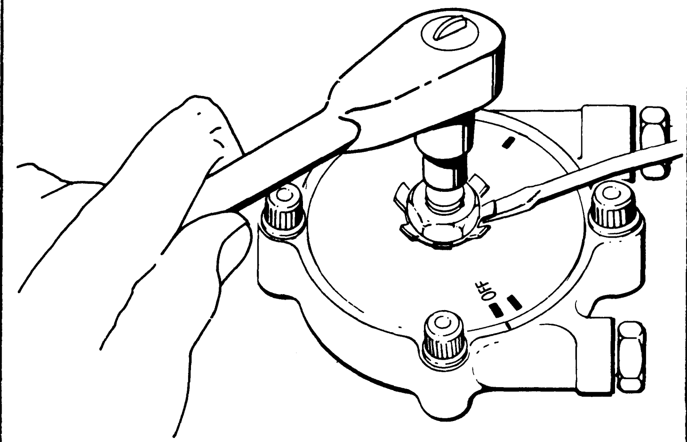
a ROTATE THE INPUT SHAFT OF THE MAIN FUEL CONTROL COUNTERCLOCKWISE TO THE STOP IN THE CONTROL WITH THROTTLE SHAFT ADAPTER WRENCH, 1C2754-3G1. POSITION THE CABLE BOX NAMEPLATE SO THAT THE **OFF** POSITION ALIGNS WITH THE REFERENCE MARK ON THE CABLE BOX.

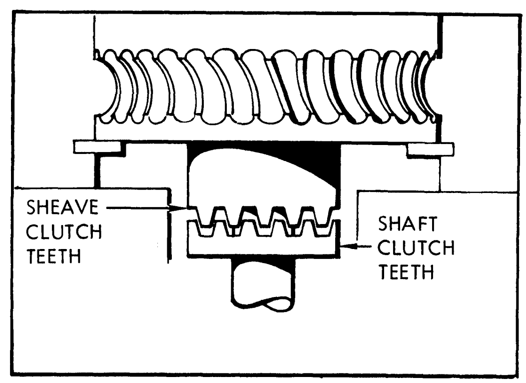


NOTE

IN THE FOLLOWING STEP, A SCREWDRIVER MAY BE INSERTED UNDER THE LOCKNUT TO GENTLY PRY THE SHAFT OUTWARD TO ASSIST ENGAGEMENT.

b HOLD THE INPUT SHAFT AT **OFF** WITH THE ADAPTER WRENCH AND INSERT A SCREWDRIVER BETWEEN THE SHAFT LOCKNUT AND THE CABLE BOX. ROTATE THE SHAFT SLIGHTLY WHILE PRYING THE INPUT SHAFT OUTWARD TO ENGAGE THE SHAFT CLUTCH TEETH TO THE CABLE BOX SHEAVE CLUTCH TEETH. TIGHTEN THE LOCKNUT FINGERTIGHT.





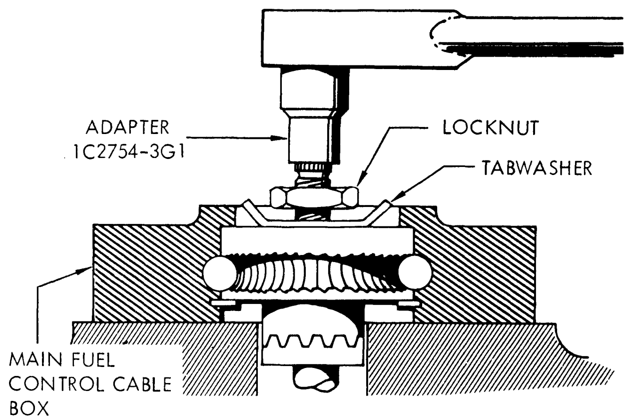
J79-B3368-2-A2

4C-2-8-(29-7)

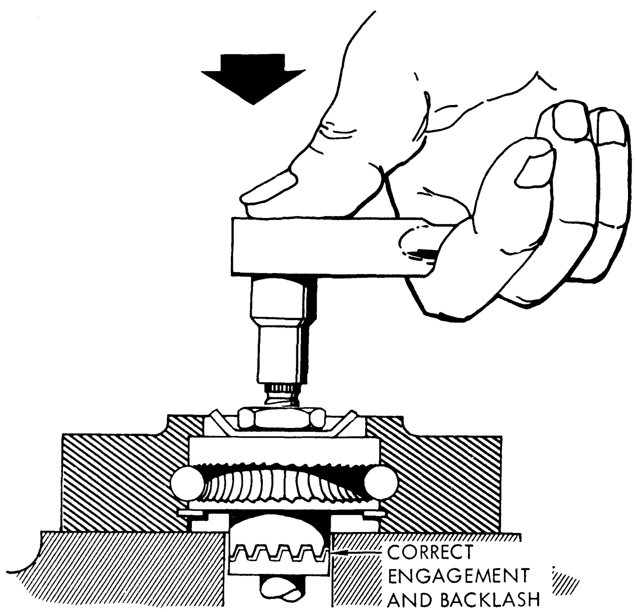
Figure 4-15. Throttle Input Linkage - BEFORE T.O. 2J-J79-1217 (Sheet 7 of 13)

3 CLUTCH ENGAGEMENT CHECK

a HOLD THE INPUT SHAFT WITH THE ADAPTER WRENCH, MARK ONE FLAT ON THE LOCKNUT AND LOOSEN THE LOCKNUT EXACTLY 1/2 TURN.



b HOLD THE CABLE BY HAND AT THE AFTERBURNER FUEL CONTROL CABLE BOX TO RESTRICT CABLE MOVEMENT. PUSH THE SHAFT IN WITH THE ADAPTER WRENCH AND TRY TO ROTATE THE SHAFT IN BOTH DIRECTIONS. IF THE SHAFT WILL NOT TURN MORE THAN THE CLUTCH TEETH BACKLASH PERMITS, THE ENGAGEMENT IS CORRECT. IF CLUTCH ENGAGEMENT IS NOT CORRECT, THE SHAFT WILL "FREE-WHEEL" AND MUST BE ENGAGED AGAIN.



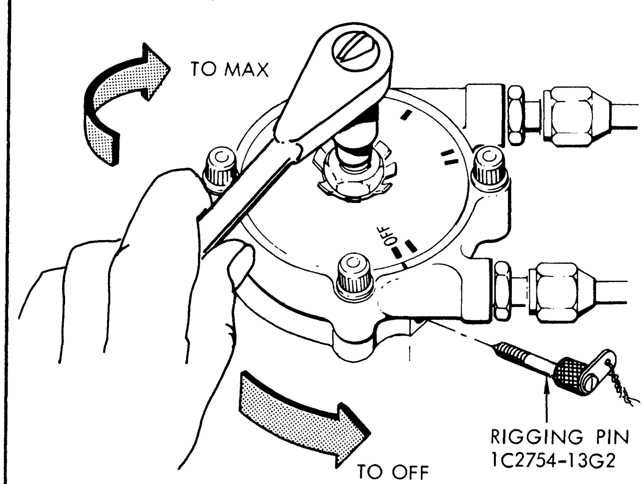
c POSITION THE CABLE BOX NAMEPLATE SO THAT THE **OFF** POSITION ALIGNS WITH THE REFERENCE MARK ON THE CABLE BOX.

d HOLD THE SHAFT WITH THE ADAPTER WRENCH AND TORQUE THE LOCKNUT TO 30-40 LB-IN. DO NOT BEND THE TABWASHER AT THIS TIME.

4 MAIN FUEL CONTROL RIGGING PIN

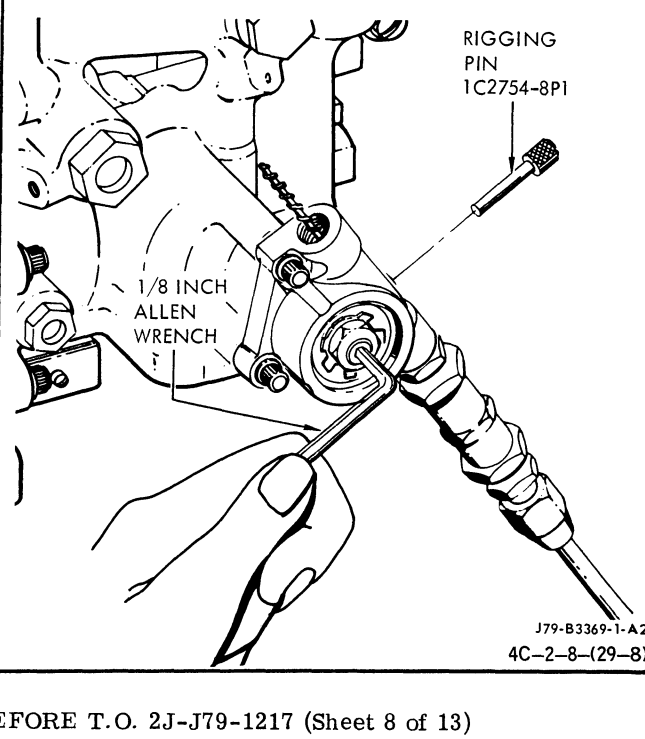
a ROTATE THE INPUT SHAFT ON THE MAIN FUEL CONTROL FROM **OFF** TO **MAX**, CHECKING FOR FREEDOM OF MOVEMENT. RETURN THE SHAFT TO **OFF**, AGAINST THE STOP IN THE CONTROL.

b THREAD THE RIGGING PIN, 1C2754-13G2, INTO THE RIGGING PORT. IF THE PIN IS PROPERLY ENGAGED, THE SHAFT WILL NOT ROTATE.



5 AFTERBURNER FUEL CONTROL SHAFT CLUTCH ENGAGEMENT

a ROTATE THE INPUT SHAFT ON THE AFTERBURNER FUEL CONTROL COUNTERCLOCKWISE TO THE STOP WITH AN ALLEN WRENCH. THEN ROTATE THE SHAFT SLOWLY CLOCKWISE UNTIL RIGGING PIN, 1C2754-8P1, CAN BE INSERTED INTO THE OPEN RIGGING PORT BELOW THE CABLE BOX.



J79-B3369-1-A2

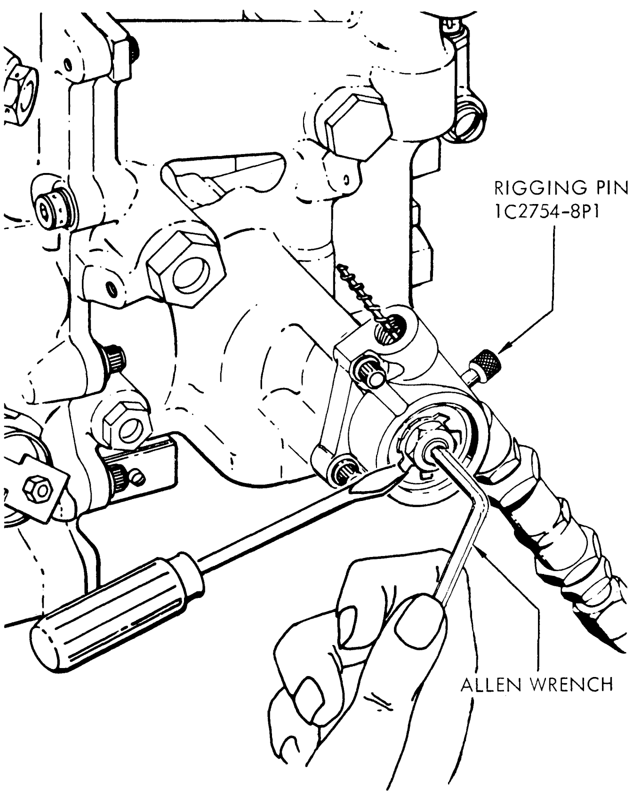
4C-2-8-(29-8)

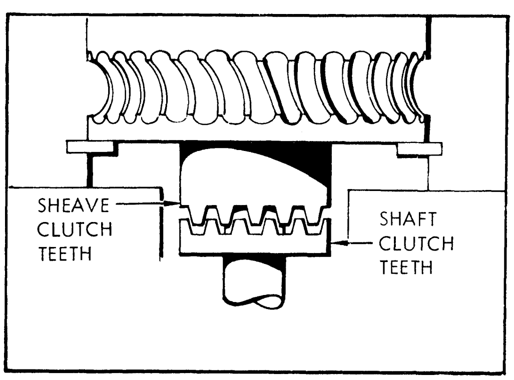
Figure 4-15. Throttle Input Linkage - BEFORE T.O. 2J-J79-1217 (Sheet 8 of 13)

5 NOTE

IN THE FOLLOWING STEP, A SCREWDRIVER MAY BE INSERTED UNDER THE LOCKNUT TO GENTLY PRY THE SHAFT OUTWARD TO ASSIST ENGAGEMENT.

b PULL THE INPUT SHAFT OUTWARD, UNTIL THERE IS CONTACT BETWEEN THE SHAFT AND CABLE BOX CLUTCH TEETH.



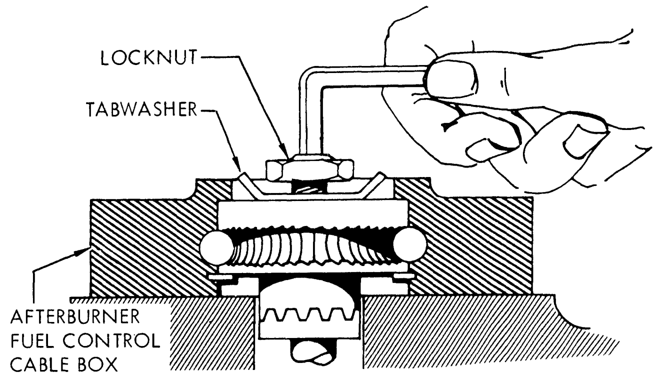


c HOLD THE INPUT SHAFT WITH THE ALLEN WRENCH, REMOVE THE RIGGING PIN, AND PULL THE INPUT SHAFT OUT COMPLETELY TO ENGAGE THE SHAFT AND CABLE BOX CLUTCH TEETH. IT MAY BE NECESSARY TO ROTATE THE INPUT SHAFT SLIGHTLY TO COMPLETE THE ENGAGEMENT.

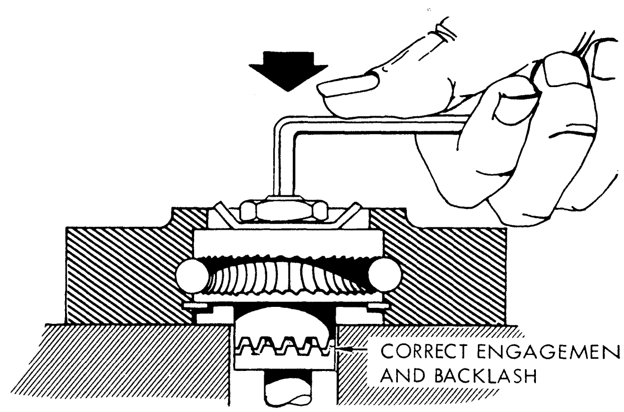
d TIGHTEN THE INPUT SHAFT LOCKNUT FINGERTIGHT.

6 CLUTCH ENGAGEMENT CHECK

a HOLD THE INPUT SHAFT WITH THE ALLEN WRENCH, MARK ONE FLAT ON THE LOCKNUT, AND LOOSEN THE LOCKNUT EXACTLY 1/2 TURN.



b PUSH THE SHAFT IN WITH THE ALLEN WRENCH AND TRY TO ROTATE THE SHAFT IN BOTH DIRECTIONS. IF THE SHAFT WILL NOT TURN MORE THAN THE CLUTCH TEETH BACKLASH PERMITS, THE ENGAGEMENT IS CORRECT. IF CLUTCH ENGAGEMENT IS NOT CORRECT, THE SHAFT WILL "FREE-WHEEL", AND MUST BE ENGAGED AGAIN.



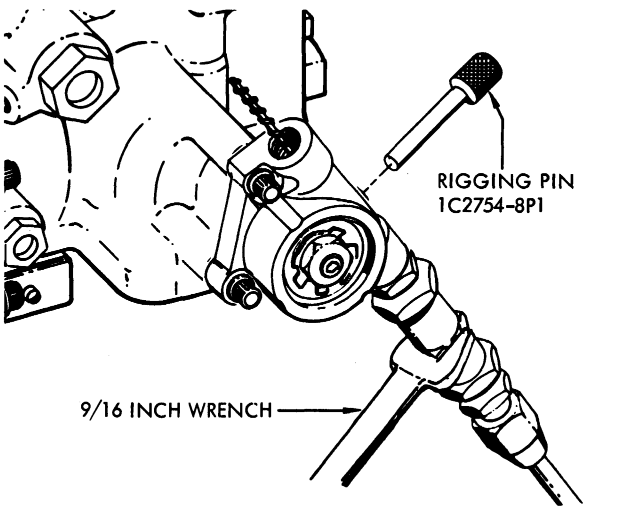
c VISUALLY CHECK THROUGH THE RIGGING PORT FOR PROPER CLUTCH ENGAGEMENT.

d HOLD THE SHAFT WITH THE ALLEN WRENCH AND TORQUE THE LOCKNUT TO 30-40 LB-IN. DO NOT BEND THE TABWASHER AT THIS TIME.

J79-B3370-3-A2
4C-2-8-(29-9)

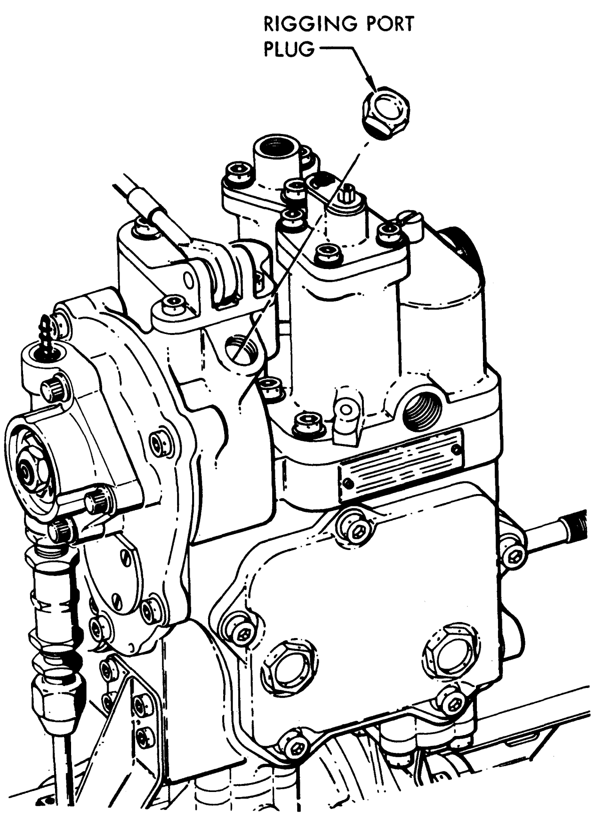
Figure 4-15. Throttle Input Linkage - BEFORE T.O. 2J-J79-1217 (Sheet 9 of 13)

6 d INSERT THE RIGGING PIN INTO THE RIGGING PORT. IF THE PIN WILL NOT FIT, ADJUST THE CABLE LENGTH AS NECESSARY BY TURNING THE MICRO-ADJUST UNIT WITH A 5/8 INCH WRENCH. THE RIGGING PIN MUST SLIDE FREELY INTO THE SHAFT CAM RIGGING SLOT. REMOVE THE RIGGING PIN.



7 NOZZLE AREA CONTROL SHAFT CLUTCH ENGAGEMENT

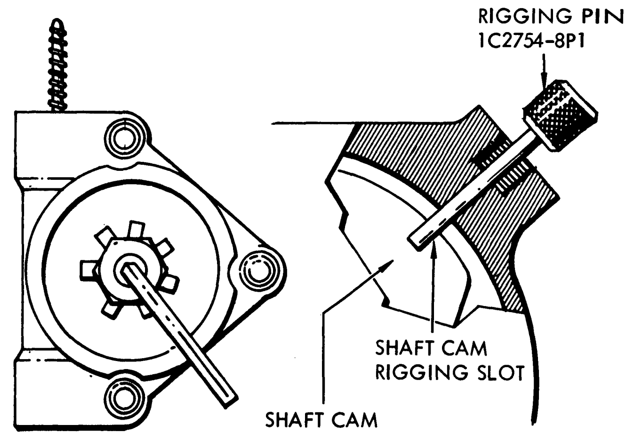
a REMOVE THE PLUG FROM THE RIGGING PORT ON THE NOZZLE AREA CONTROL.

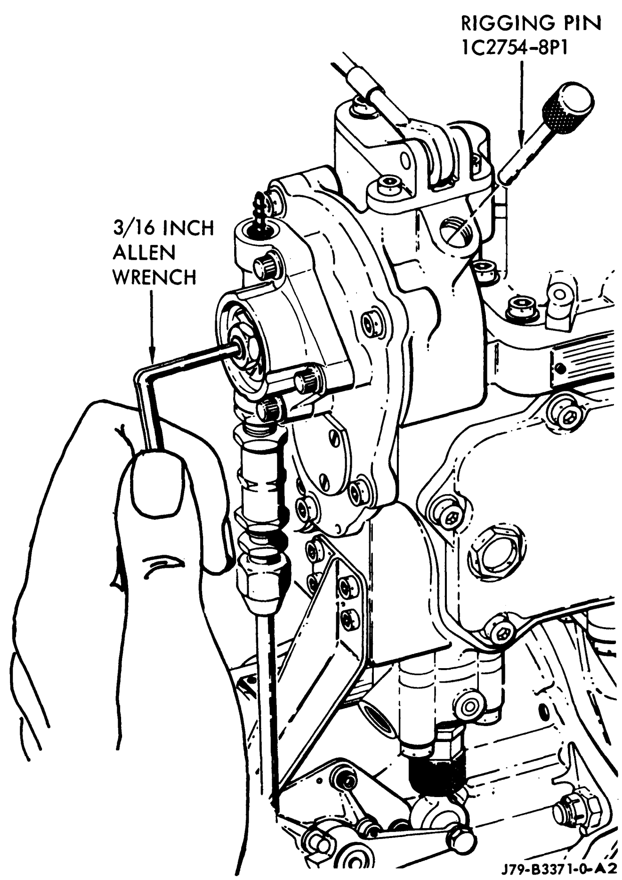


NOTE

IN THE FOLLOWING STEP, THE INPUT SHAFT ON THE NOZZLE AREA CONTROL CAN BE ROTATED 360 DEGREES WITHOUT DAMAGE TO THE CONTROL. THE SHAFT WILL NOT ROTATE IN EITHER DIRECTION WHEN THE RIGGING PIN IS INSTALLED PROPERLY.

b ROTATE THE NOZZLE AREA CONTROL INPUT SHAFT WITH AN ALLEN WRENCH UNTIL RIGGING PIN, 1C2754-8P1, FITS INTO THE SHAFT CAM RIGGING SLOT.





4C-2-8-(29-10)B

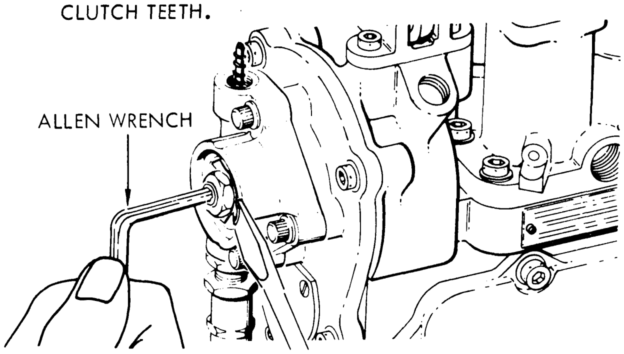
Figure 4-15. Throttle Input Linkage - BEFORE T.O. 2J-J79-1217 (Sheet 10 of 13)

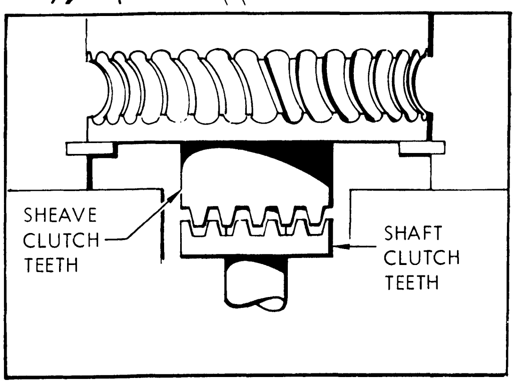
7

NOTE

IN THE FOLLOWING STEP, A SCREW-DRIVER MAY BE INSERTED UNDER THE LOCKNUT TO GENTLY PRY THE SHAFT OUTWARD TO ASSIST ENGAGEMENT.

c PULL THE INPUT SHAFT OUTWARD, UNTIL THERE IS CONTACT BETWEEN THE SHAFT AND CABLE BOX CLUTCH TEETH.



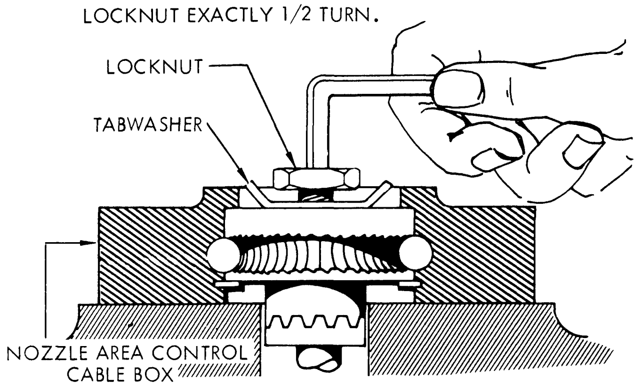


d HOLD THE INPUT SHAFT WITH THE ALLEN WRENCH, REMOVE THE RIGGING PIN, AND PULL THE INPUT SHAFT OUT COMPLETELY TO ENGAGE THE SHAFT AND CABLE BOX CLUTCH TEETH. IT MAY BE NECESSARY TO ROTATE THE INPUT SHAFT SLIGHTLY TO COMPLETE THE ENGAGEMENT.

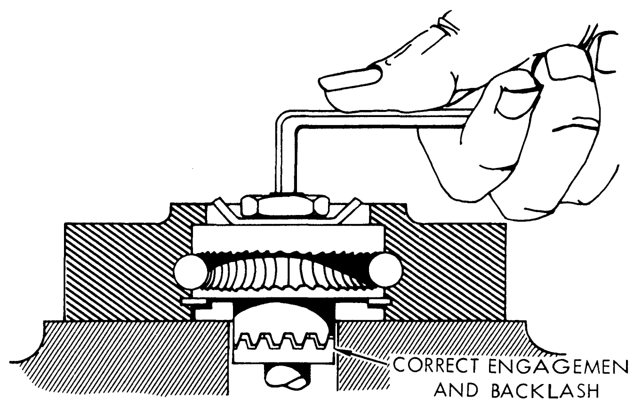
e TIGHTEN THE LOCKNUT FINGERTIGHT.

8 **CLUTCH ENGAGEMENT CHECK**

a HOLD THE INPUT SHAFT WITH THE ALLEN WRENCH, MARK ONE FLAT ON THE LOCKNUT AND LOOSEN THE LOCKNUT EXACTLY 1/2 TURN.

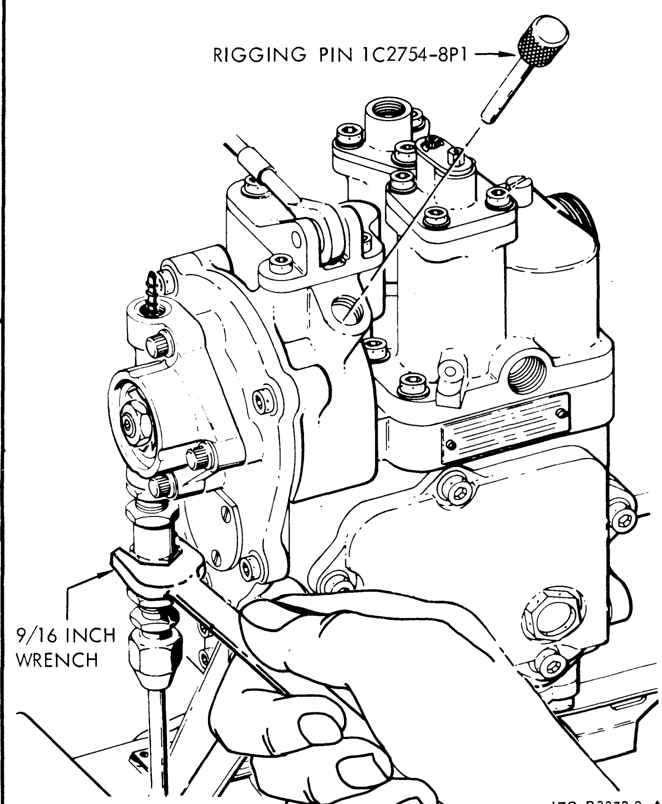


b PUSH THE SHAFT IN WITH THE ALLEN WRENCH AND TRY TO ROTATE THE SHAFT IN BOTH DIRECTIONS. IF THE SHAFT WILL NOT TURN MORE THAN THE CLUTCH TEETH BACKLASH PERMITS, THE ENGAGEMENT IS CORRECT. IF CLUTCH ENGAGEMENT IS NOT CORRECT, THE SHAFT WILL "FREE-WHEEL", AND MUST BE ENGAGED AGAIN.



c HOLD THE SHAFT WITH THE ALLEN WRENCH AND TORQUE THE LOCKNUT TO 30-40 LB-IN. DO NOT BEND THE TABWASHER AT THIS TIME.

d INSERT THE RIGGING PIN INTO THE RIGGING PORT. IF THE PIN WILL NOT FIT, ADJUST THE CABLE LENGTH AS NECESSARY BY TURNING THE MICRO-ADJUST UNIT WITH A 9/16 INCH WRENCH. THE RIGGING PIN MUST SLIDE FREELY INTO THE SHAFT CAM RIGGING SLOT. REMOVE THE RIGGING PIN.



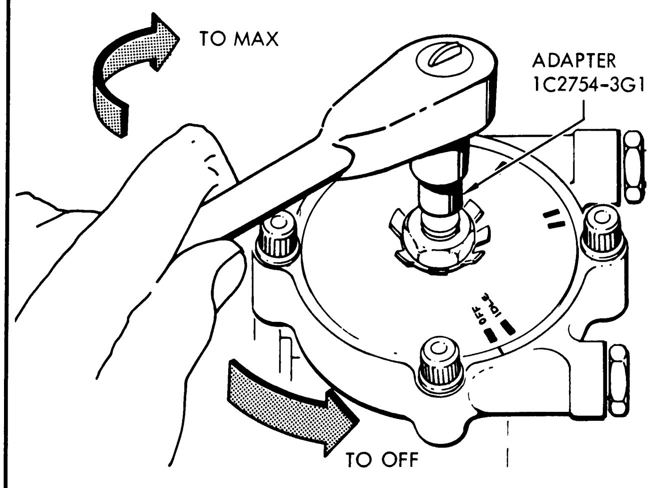
4C-2-8-(29-11

Figure 4-15. Throttle Input Linkage - BEFORE T.O. 2J-J79-1217 (Sheet 11 of 13)

9 RIGGING CHECKS

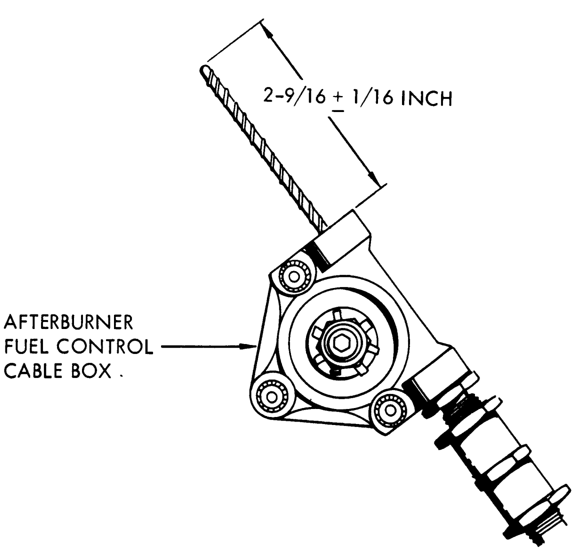
a REMOVE THE RIGGING PIN FROM THE MAIN FUEL CONTROL.

b ROTATE THE MAIN FUEL CONTROL THROTTLE SHAFT THROUGHOUT ITS FULL TRAVEL, **OFF** TO **MAX**. DETERMINE THAT MOVEMENT IS FREE, WITHOUT BINDING.

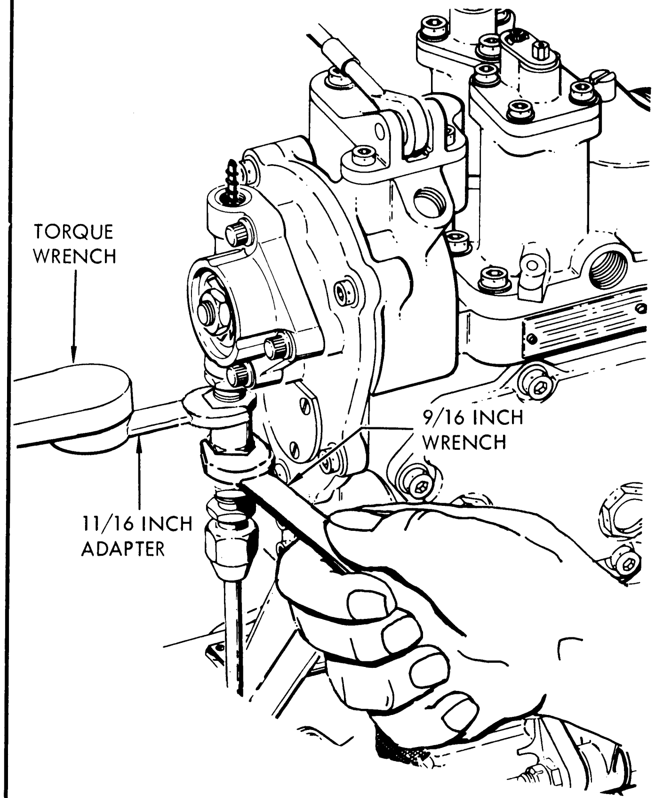


c HOLD THE MAIN FUEL CONTROL AT **OFF**, AND TRY THE RIGGING PIN IN BOTH THE AFTERBURNER FUEL CONTROL AND NOZZLE AREA CONTROL AGAIN. MAKE ADJUSTMENTS AS NECESSARY WITH THE MICRO-ADJUST UNITS UNTIL THE RIGGING PIN SLIDES FREELY INTO THE SHAFT CAM RIGGING SLOTS. REMOVE THE RIGGING PIN.

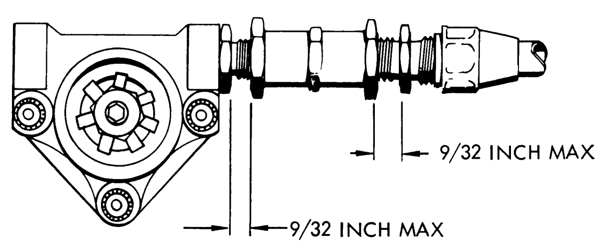
d HOLD THE MAIN FUEL CONTROL AT THE **OFF** POSITION, CHECK THAT THE CABLE EXTENDS 2-9/16 ± 1/16 INCHES PAST THE CABLE BOX ON THE AFTERBURNER FUEL CONTROL.



e TORQUE THE TWO MICRO-ADJUST UNIT JAM NUTS TO 50-60 LB-IN. DO NOT ALLOW THE COUPLINGS ON THE MICRO-ADJUST UNITS TO ROTATE WHILE TORQUING THE JAM NUTS.



f MEASURE THE DISTANCE BETWEEN EACH JAM NUT AND THE CORRESPONDING CONNECTOR HEX. IF THE MEASUREMENT EXCEEDS 9/32 INCH, POSITIVE ENGAGEMENT OF THE CONNECTORS IN THE COUPLINGS IS NOT CORRECT; RE-RIG THE SYSTEM.

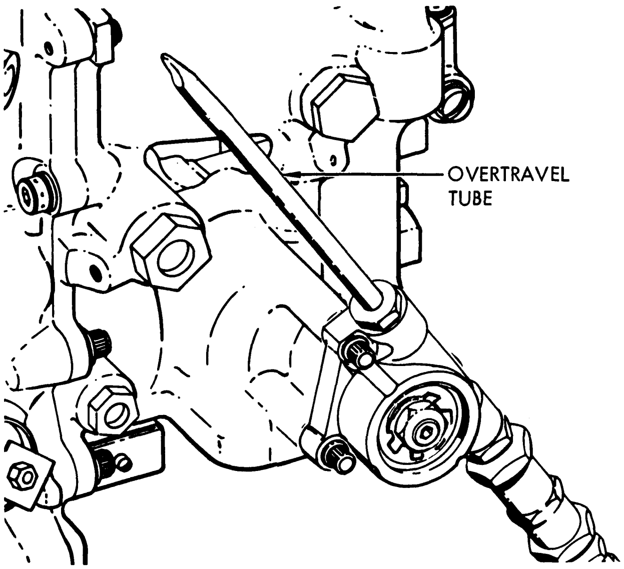


J79-B3373-2-A2
4C-2-8-(29-12)

Figure 4-15. Throttle Input Linkage - BEFORE T.O. 2J-J79-1217 (Sheet 12 of 13)

10 FINAL INSTALLATION

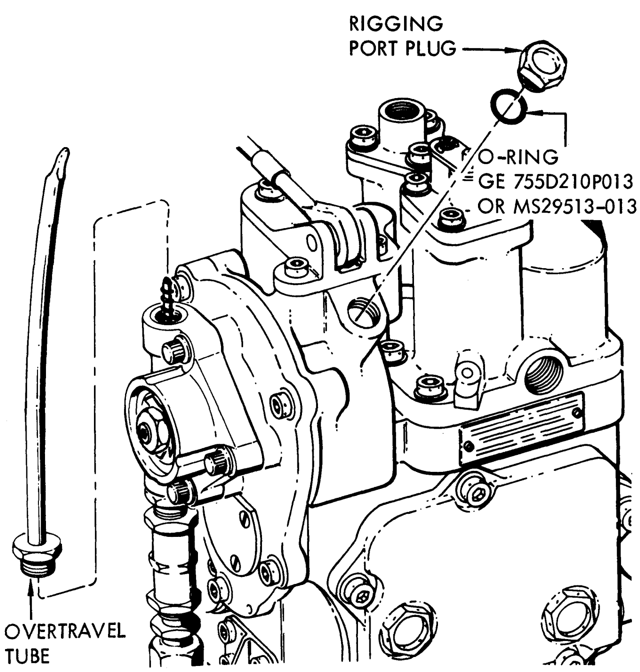
a INSTALL THE STRAIGHT OVERTRAVEL TUBE IN THE CABLE BOX ON THE AFTERBURNER FUEL CONTROL; TORQUE TO 10-20 LB-IN.



b INSTALL THE CURVED OVERTRAVEL TUBE IN THE CABLE BOX ON THE NOZZLE AREA CONTROL; TORQUE TO 10-20 LB-IN.

c ROTATE THE MAIN FUEL CONTROL THROTTLE SHAFT THROUGHOUT ITS FULL TRAVEL, **OFF** TO **MAX.** DETERMINE THAT MOVEMENT IS FREE, WITHOUT BINDING.

d ASSEMBLE A NEW O-RING (GE 755D210P013) ON THE RIGGING PORT PLUG; INSTALL IN THE RIGGING PORT ON THE NOZZLE AREA CONTROL; TORQUE TO 20-30 LB-IN. AND LOCKWIRE.



11 SECURING THE SYSTEM

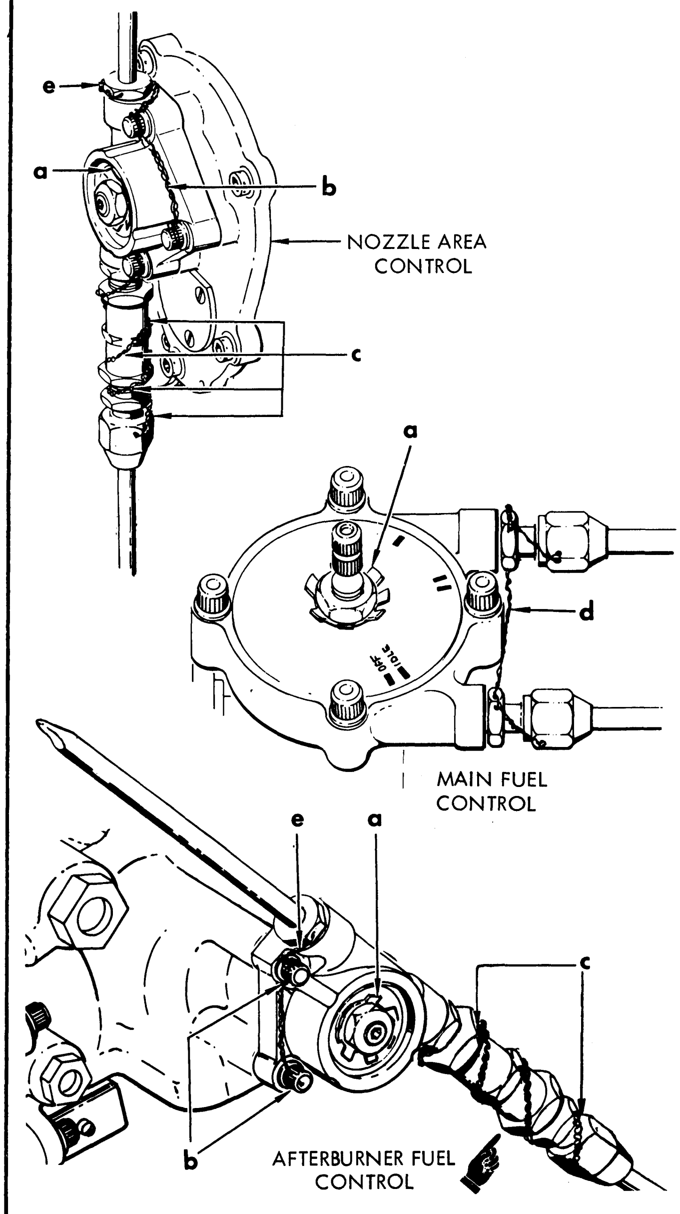
a BEND A TAB ON THE TABWASHER AGAINST A LOCKNUT FLAT ON EACH CONTROL SHAFT LOCKNUT.

b LOCKWIRE THE TWO UPPER MOUNTING BOLTS ON THE AFTERBURNER FUEL AND NOZZLE AREA CONTROL CABLE BOXES.

c LOCKWIRE EACH CONDUIT COUPLING NUT TO THE MICRO-ADJUST UNIT AND THEN TO THE NEAREST CABLE BOX MOUNTING BOLT.

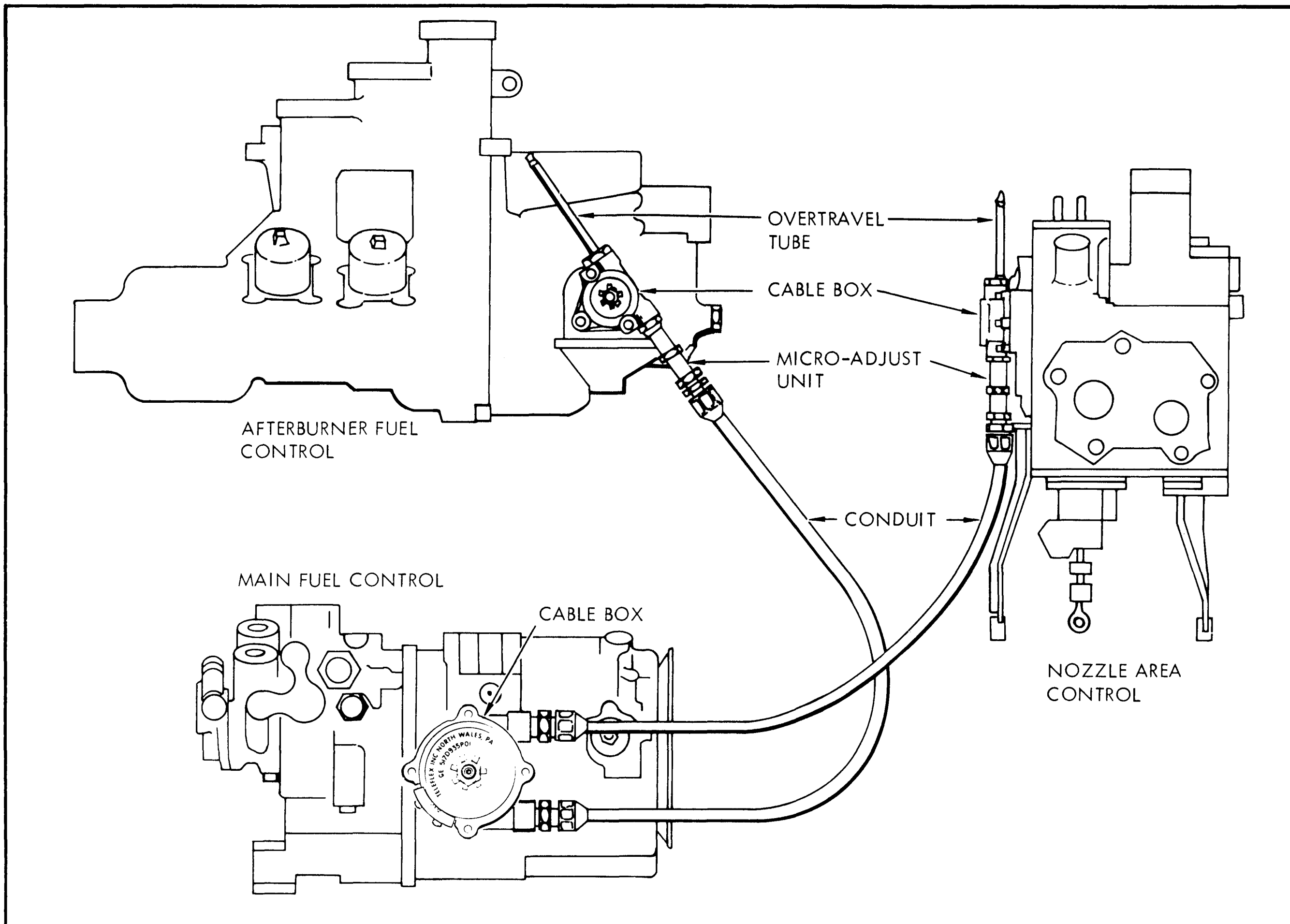
d LOCKWIRE EACH CONDUIT COUPLING NUT TO THE CABLE BOX ADAPTERS ON THE MAIN FUEL CONTROL.

e LOCKWIRE EACH OVERTRAVEL TUBE TO THE NEAREST CABLE BOX MOUNTING BOLT.



J79-B3374-2-A2
4C-2-8-(29-13)A

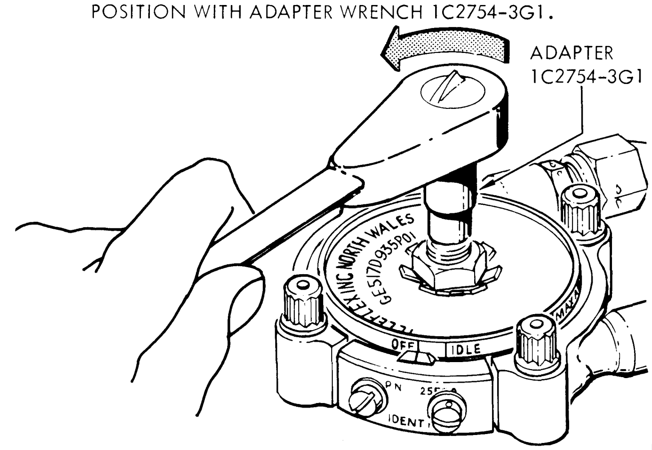
Figure 4-15. Throttle Input Linkage - BEFORE T.O. 2J-J79-1217 (Sheet 13 of 13)



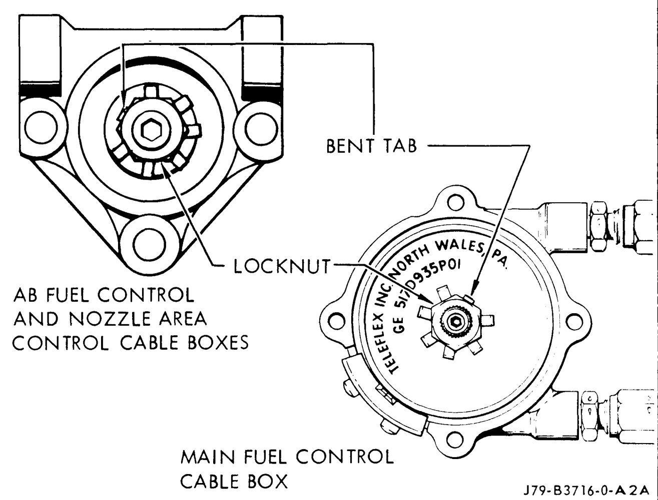
REMOVAL

1 CLUTCH DISENGAGEMENT

a ROTATE THE THROTTLE INPUT SHAFT ON THE MAIN FUEL CONTROL COUNTERCLOCKWISE TO THE **OFF** POSITION WITH ADAPTER WRENCH 1C2754-3G1.



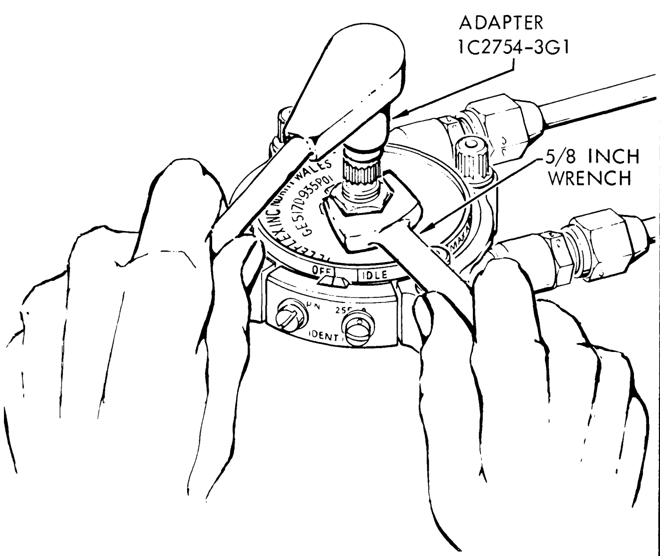
b STRAIGHTEN THE BENT TAB ON THE TABWASHER UNDER THE LOCKNUTS ON THE THROTTLE INPUT SHAFTS OF THE AFTERBURNER FUEL, MAIN FUEL AND NOZZLE AREA CONTROLS.



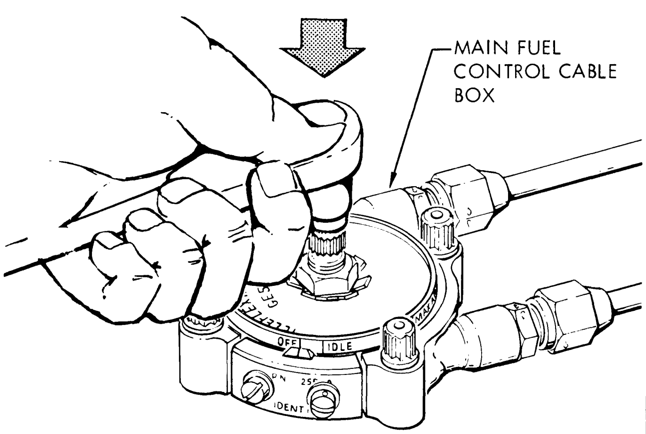
4C-2-8-(30-1)

Figure 4-16. Throttle Input Linkage - AFTER T.O. 2J-J79-1217 (Sheet 1 of 14)

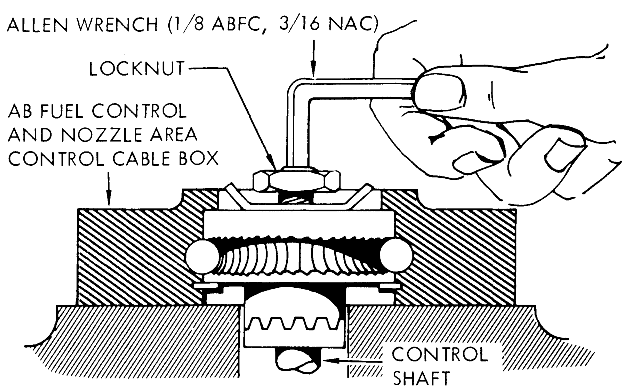
1 c HOLD THE INPUT SHAFT OF THE MAIN FUEL CONTROL WITH THE ADAPTER WRENCH AND LOOSEN THE LOCKNUT 1-1/2 TURNS WITH A 5/8 INCH WRENCH.



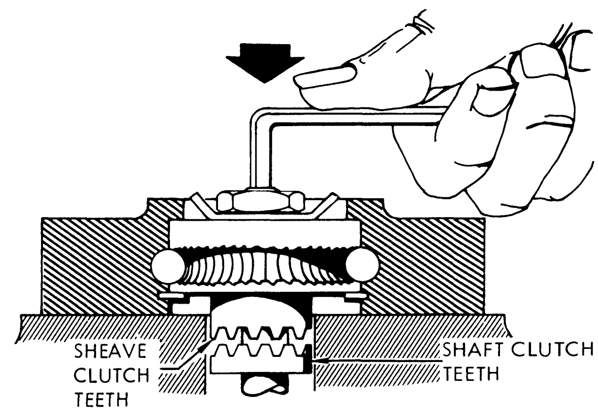
d PUSH THE SHAFT INWARD WITH THE WRENCH TO DISENGAGE THE SHAFT CLUTCH TEETH FROM THE CABLE BOX SHEAVE CLUTCH TEETH.



e HOLD THE INPUT SHAFTS OF THE AFTERBURNER FUEL AND NOZZLE AREA CONTROLS WITH AN ALLEN WRENCH AND LOOSEN EACH LOCKNUT AT LEAST 1-1/2 TURNS WITH A 9/16 INCH WRENCH.

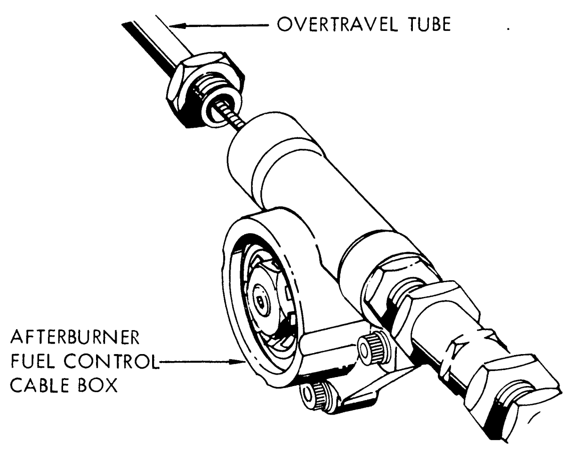


f PUSH EACH SHAFT INWARD WITH THE ALLEN WRENCH TO DISENGAGE THE SHAFT CLUTCH TEETH FROM THE CABLE BOX SHEAVE CLUTCH TEETH.

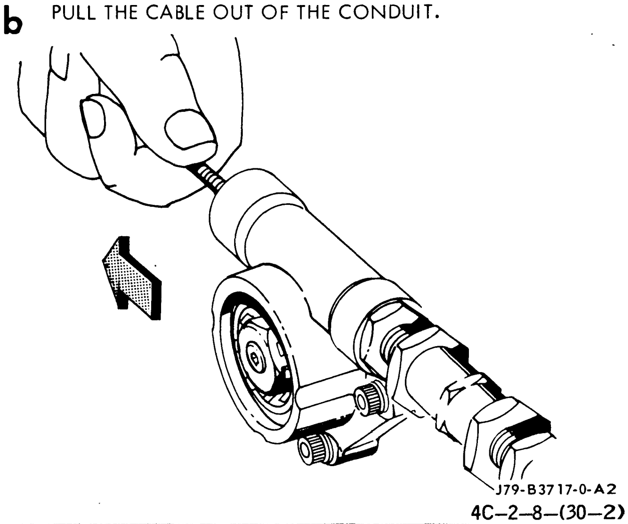


2 CABLE RELEASE

a REMOVE THE OVERTRAVEL TUBE FROM THE AFTERBURNER FUEL CONTROL CABLE BOX.



b PULL THE CABLE OUT OF THE CONDUIT.



4C-2-8-(30-2)

Figure 4-16. Throttle Input Linkage - AFTER T.O. 2J-J79-1217 (Sheet 2 of 14)

3 COMPLETE DISASSEMBLY

a DISCONNECT THE TWO CONDUITS AT THE MICRO-ADJUST UNITS AND AT THE MAIN FUEL CONTROL CABLE BOX. REMOVE THE OVERTRAVEL TUBE FROM THE NOZZLE AREA CONTROL CABLE BOX.

b DISCONNECT THE MICRO-ADJUST UNITS AT THE CABLE BOXES ON THE AFTERBURNER FUEL AND NOZZLE AREA CONTROLS. REMOVE THE ADAPTERS FROM THE CABLE BOX ON THE MAIN FUEL CONTROL.

NOTE

IN THE FOLLOWING STEP, IF A CABLE BOX IS DIFFICULT TO REMOVE, DO NOT USE FORCE (WHICH MAY CAUSE INTERNAL DAMAGE TO THE CONTROL); RETURN THE CONTROL, WITH THE CABLE BOX ATTACHED, TO OVERHAUL.

c REMOVE THE LOCKNUT AND TABWASHER FROM EACH CONTROL INPUT SHAFT; REMOVE THE MOUNTING BOLTS AND WASHERS FROM EACH CABLE BOX. REMOVE THE BOXES. DISCARD THE TABWASHERS.

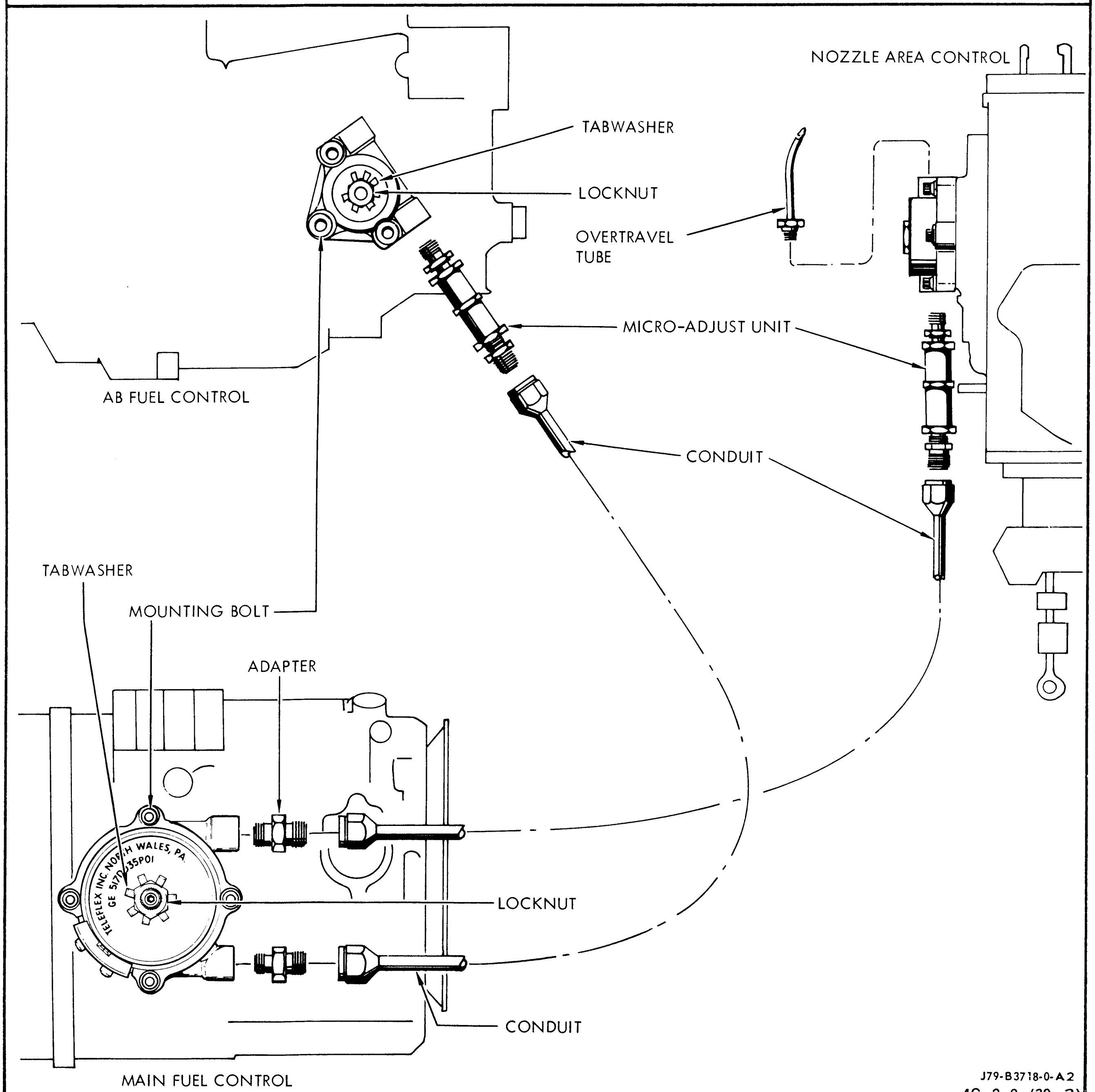


Figure 4-16. Throttle Input Linkage - AFTER T.O. 2J-J79-1217 (Sheet 3 of 14)

INSTALLATION

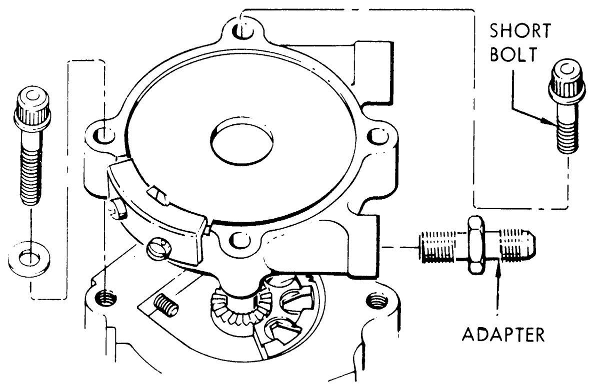
1 CABLE BOX AND ADAPTERS

NOTE

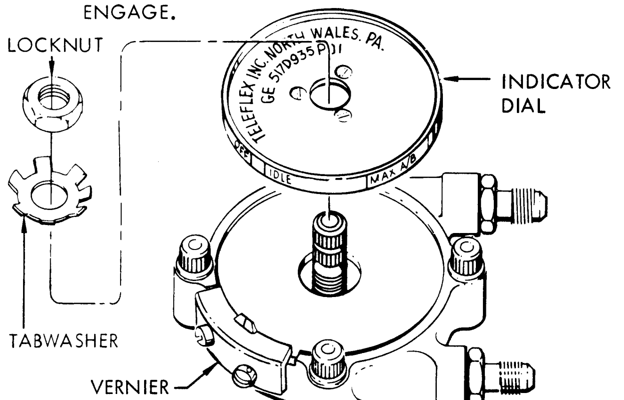
IN THE FOLLOWING STEP, ONLY THE SHORT BOLT WILL BE PERMANENTLY INSTALLED. THE THREE REMAINING ARE SLAVE BOLTS, IN PLACE TO MAKE RIGGING POSSIBLE.

a PLACE THE CABLE BOX IN POSITION ON THE MAIN FUEL CONTROL AND SECURE WITH FOUR BOLTS AND THREE WASHERS. INSTALL THE SHORT BOLT, WITHOUT A WASHER, THROUGH THE UPPER MOUNTING HOLE NEAREST THE COMPRESSOR CASING. TORQUE THE BOLTS TO 24-27 LB-IN. LOCKWIRE THE SHORT BOLT TO THE COMPRESSOR DISCHARGE PRESSURE TUBE COUPLING NUT ON THE CONTROL.

b INSTALL THE TWO ADAPTERS ON THE MAIN FUEL CONTROL CABLE BOX; TORQUE THE ADAPTERS TO 50-60 LB-IN. A GAP OF 5/64 INCH MAX BETWEEN THE ADAPTER HEX AND THE CABLE BOX IS PERMISSIBLE IF PROPERLY TORQUED.



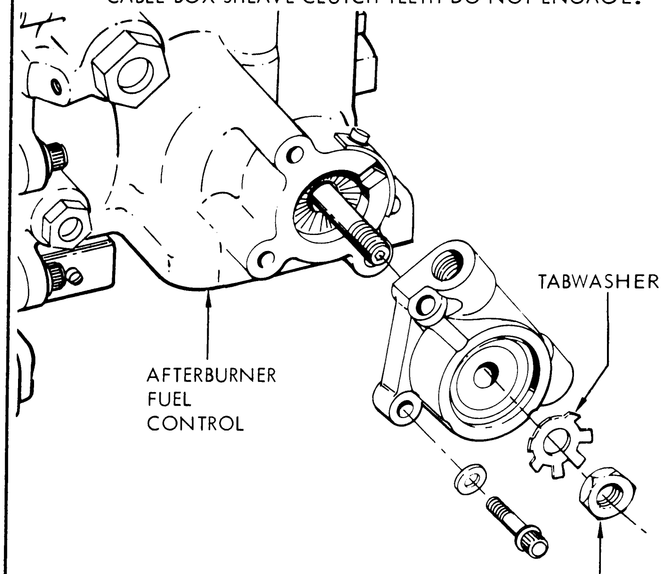
c INSTALL THE INDICATOR DIAL, LOCKNUT, AND A NEW TABWASHER ON THE INPUT SHAFT. MAKE SURE THAT THE LOCKNUT IS LOOSENED AT LEAST 1-1/2 TURNS AND THAT THE SHAFT IS PUSHED INWARD SO THAT THE SHAFT AND CABLE BOX SHEAVE CLUTCH TEETH DO NOT ENGAGE.

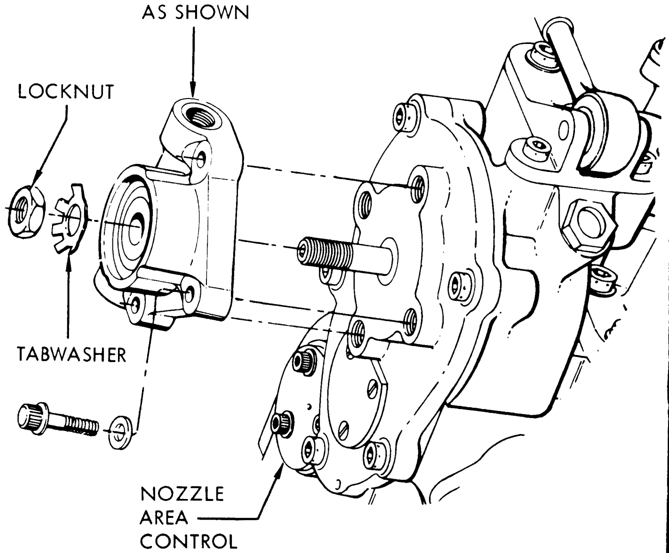


2 CABLE BOXES

a INSTALL THE CABLE BOXES ON THE AFTERBURNER FUEL AND NOZZLE AREA CONTROLS, USING THREE BOLTS AND WASHERS FOR EACH BOX; TIGHTEN FINGERTIGHT.

b INSTALL A NEW TABWASHER AND LOCKNUT ON EACH INPUT SHAFT. MAKE SURE THAT THE LOCKNUTS ARE LOOSENED AT LEAST 1-1/2 TURNS AND THAT THE SHAFTS ARE PUSHED INWARD SO THAT THE SHAFT AND CABLE BOX SHEAVE CLUTCH TEETH DO NOT ENGAGE.





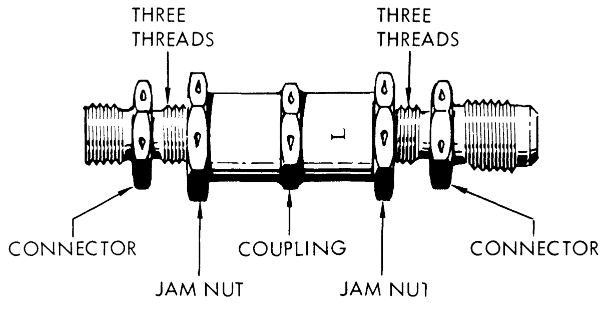
J79-B3719-0-A2A

4C-2-8-(30-4)

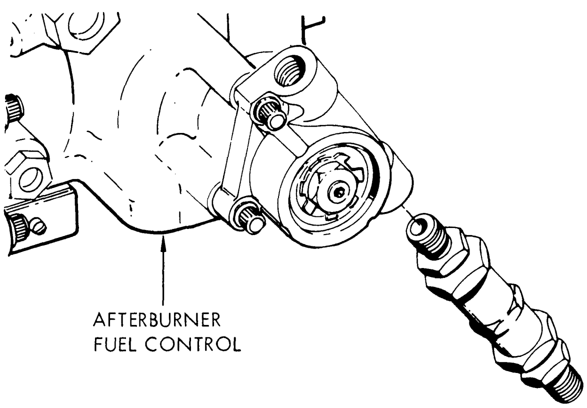
Figure 4-16. Throttle Input Linkage - AFTER T.O. 2J-J79-1217 (Sheet 4 of 14)

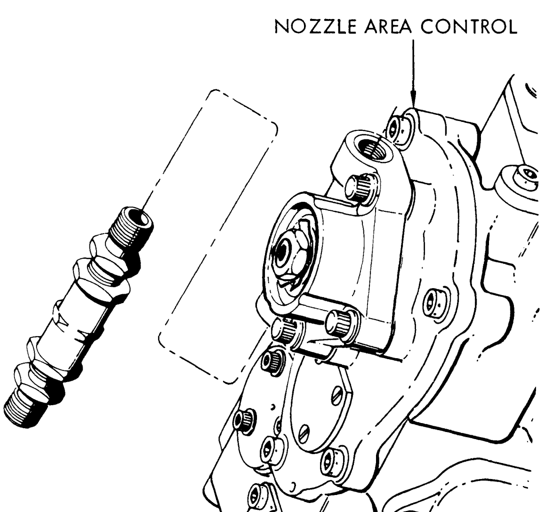
3 MICRO-ADJUST UNITS

a CENTER THE MICRO-ADJUST UNITS. WITH THE JAM NUTS RUN UP AGAINST THE MICRO-ADJUST COUPLING FINGERTIGHT, THREE THREADS MUST SHOW BETWEEN EACH JAM NUT AND THE CORRESPONDING CONNECTOR HEX.



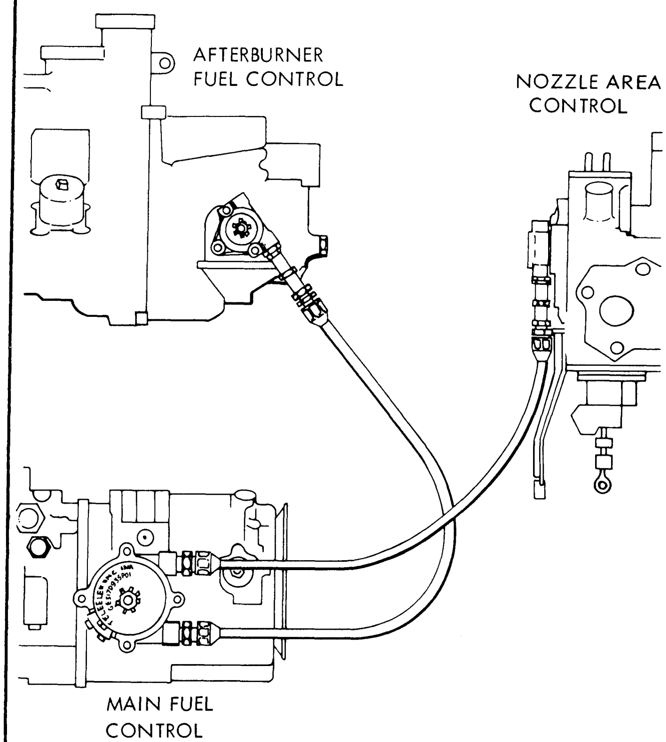
b THREAD THE MICRO-ADJUST UNITS INTO THE CABLE BOXES ON THE AFTERBURNER FUEL AND NOZZLE AREA CONTROLS; TORQUE THE CONNECTORS TO 50-60 LB-IN. A GAP OF 5/64 INCH MAX BETWEEN THE CONNECTOR HEX AND THE CABLE BOX IS PERMISSIBLE IF PROPERLY TORQUED.





4 CONDUIT

a CONNECT THE TWO CONDUITS TO THE MAIN FUEL CONTROL CABLE BOX ADAPTERS; CONNECT THE OTHER ENDS TO THE MICRO-ADJUST UNITS ON THE AFTERBURNER FUEL AND NOZZLE AREA CONTROL CABLE BOXES. IF NECESSARY, THE CABLE BOX MOUNTING BOLTS MAY BE REMOVED TO INSTALL THE CONDUITS.



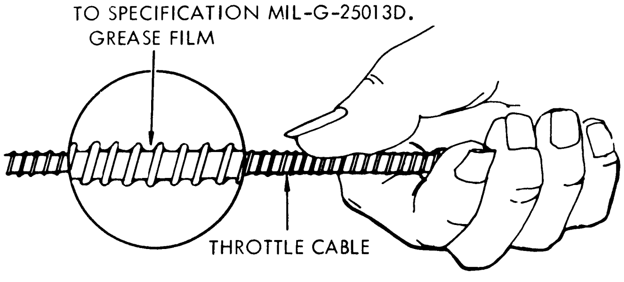
b POSITION THE CONDUITS TO PROVIDE THE LEAST AMOUNT OF STRESS ON THE PARTS. TORQUE THE THREE MOUNTING BOLTS ON EACH CABLE BOX TO 24-27 LB-IN. TORQUE ALL CONDUIT COUPLING NUTS TO 60-80 LB-IN.

J79-B3720-0-A2
4C-2-8-(30-5)

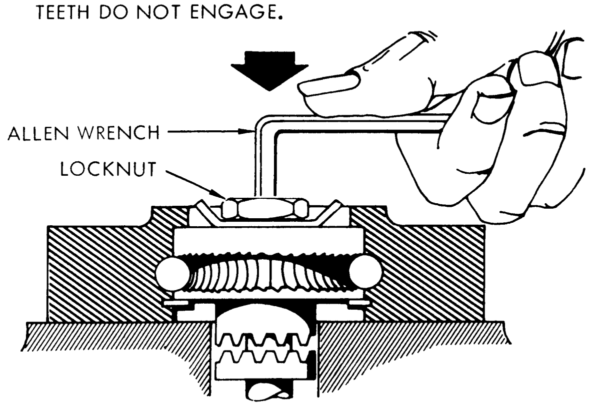
Figure 4-16. Throttle Input Linkage - AFTER T.O. 2J-J79-1217 (Sheet 5 of 14)

5 CABLE INSTALLATION

a LUBRICATE THE CABLE LIGHTLY WITH SILICONE GREASE (DOW-CORNING 33, LIGHT) OR GREASE CONFORMING TO SPECIFICATION MIL-G-25013D.



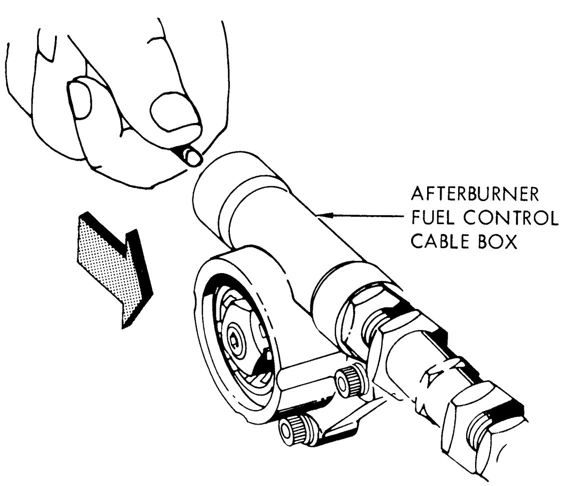
b MAKE SURE THAT EACH CONTROL INPUT SHAFT LOCKNUT IS LOOSENED AT LEAST 1-1/2 TURNS AND THAT THE SHAFT OF EACH CONTROL IS PUSHED INWARD SO THAT THE SHAFT AND CABLE BOX SHEAVE CLUTCH TEETH DO NOT ENGAGE.



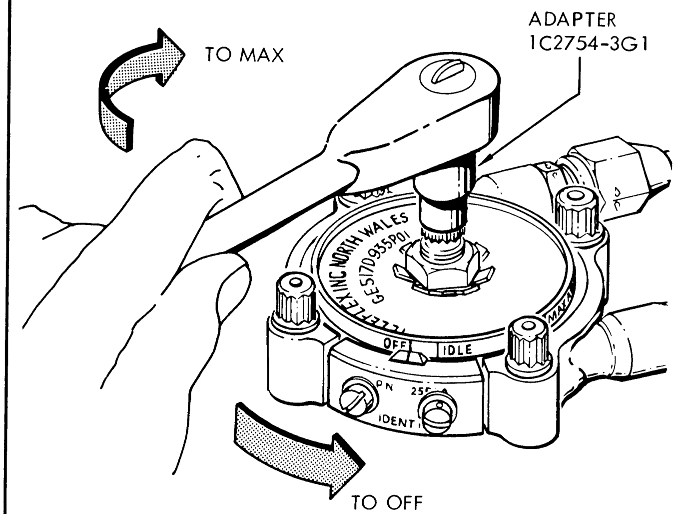
NOTE

IN THE FOLLOWING STEP, THERE MAY BE SOME DIFFICULTY IN GETTING THE CABLE THROUGH THE CABLE BOX ON THE MAIN FUEL CONTROL BECAUSE OF THE SHARP BEND REQUIRED WHEN THE CABLE REVERSES DIRECTION.

c INSERT THE CABLE INTO THE CABLE BOX ON THE AFTERBURNER FUEL CONTROL.



d IF NECESSARY TO ASSIST THE CABLE THROUGH THE MAIN FUEL CONTROL CABLE BOX, INSTALL THE THROTTLE SHAFT ADAPTER WRENCH, 1C2754-3G1, ON THE MAIN FUEL CONTROL THROTTLE SHAFT; ROTATE THE SHAFT TO **OFF**, PULL THE SHAFT OUTWARD, TIGHTEN THE SHAFT LOCKNUT AND ROTATE THE SHAFT TO **MAX**, LOOSEN THE LOCKNUT AND PUSH THE SHAFT INWARD; ROTATE THE SHAFT TO **OFF**. REPEAT AS NECESSARY.



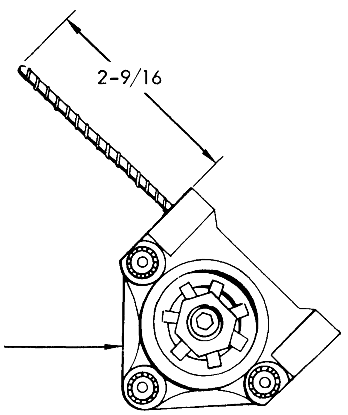
J79-B3721-0-A2
4C-2-8-(30-6)

Figure 4-16. Throttle Input Linkage - AFTER T.O. 2J-J79-1217 (Sheet 6 of 14)

RIGGING

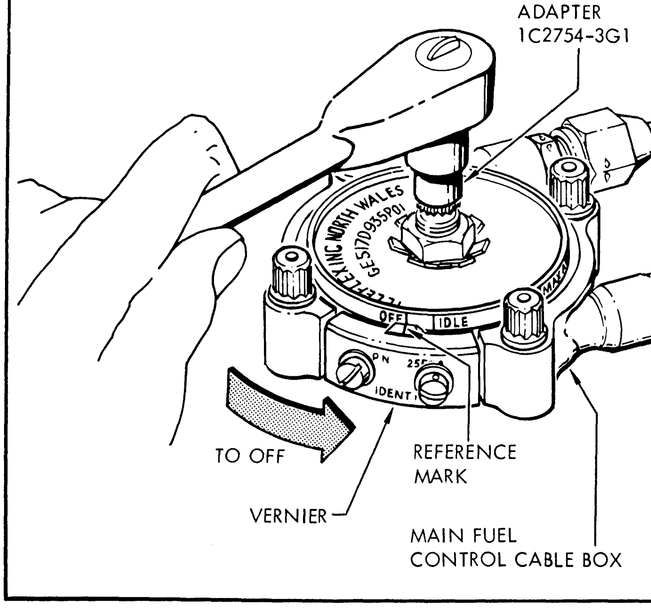
1 CABLE POSITION

POSITION THE CABLE SO THAT 2-9/16 INCHES EXTEND FROM THE CABLE BOX ON THE AFTERBURNER FUEL CONTROL.



2 MAIN FUEL CONTROL SHAFT CLUTCH ENGAGEMENT

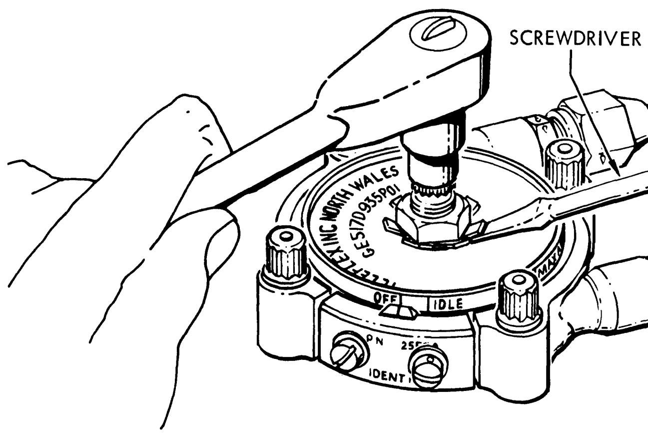
a ROTATE THE INPUT SHAFT OF THE MAIN FUEL CONTROL COUNTERCLOCKWISE TO THE STOP IN THE CONTROL WITH THROTTLE SHAFT ADAPTER WRENCH, 1C2754-3G1. POSITION THE CABLE BOX INDICATOR DIAL SO THAT THE **OFF** POSITION ALIGNS WITH THE REFERENCE MARK ON THE CABLE BOX VERNIER.

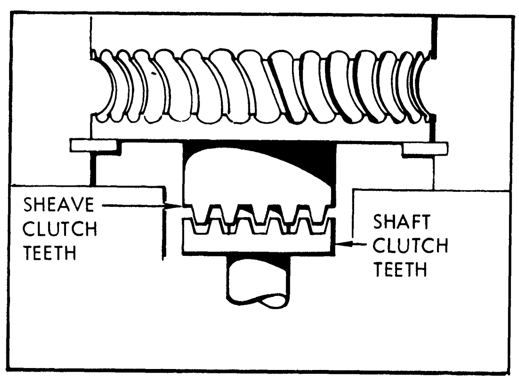


NOTE

IN THE FOLLOWING STEP, A SCREWDRIVER MAY BE INSERTED UNDER THE LOCKNUT TO GENTLY PRY THE SHAFT OUTWARD TO ASSIST ENGAGEMENT.

b HOLD THE INPUT SHAFT AT **OFF** WITH THE ADAPTER WRENCH AND INSERT A SCREWDRIVER BETWEEN THE SHAFT LOCKNUT AND THE CABLE BOX. ROTATE THE SHAFT SLIGHTLY WHILE PRYING THE INPUT SHAFT OUTWARD TO ENGAGE THE SHAFT CLUTCH TEETH TO THE CABLE BOX SHEAVE CLUTCH TEETH. TIGHTEN THE LOCKNUT FINGERTIGHT.





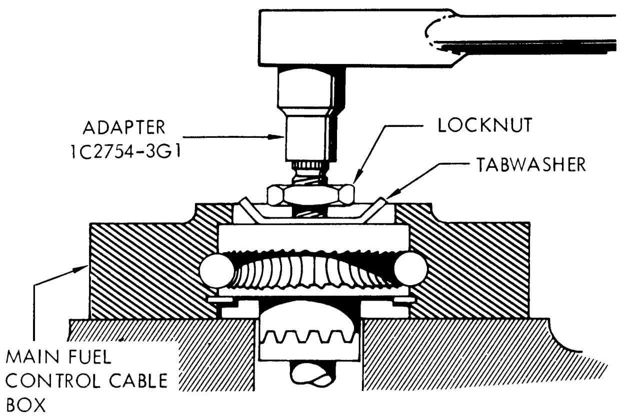
J79-B3722-0-A2A

4C-2-8-(30-7)

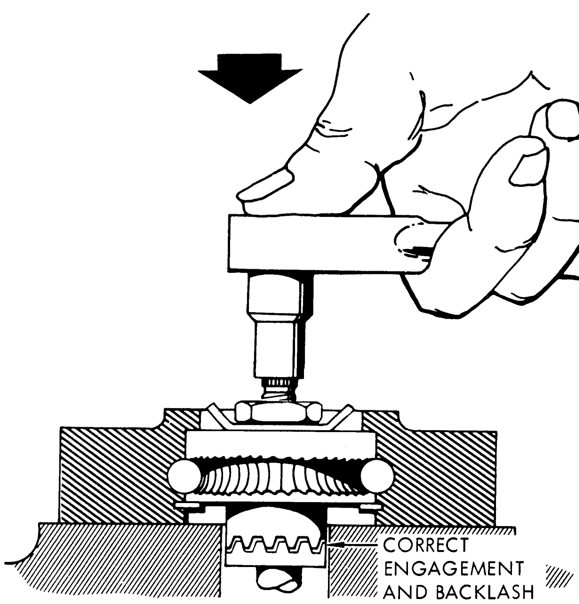
Figure 4-16. Throttle Input Linkage - AFTER T.O. 2J-J79-1217 (Sheet 7 of 14)

3 CLUTCH ENGAGEMENT CHECK

a HOLD THE INPUT SHAFT WITH THE ADAPTER WRENCH, MARK ONE FLAT ON THE LOCKNUT AND LOOSEN THE LOCKNUT EXACTLY 1/2 TURN.



b HOLD THE CABLE BY HAND AT THE AFTERBURNER FUEL CONTROL CABLE BOX TO RESTRICT CABLE MOVEMENT. PUSH THE SHAFT IN WITH THE ADAPTER WRENCH AND TRY TO ROTATE THE SHAFT IN BOTH DIRECTIONS. IF THE SHAFT WILL NOT TURN MORE THAN THE CLUTCH TEETH BACKLASH PERMITS, THE ENGAGEMENT IS CORRECT. IF CLUTCH ENGAGEMENT IS NOT CORRECT, THE SHAFT WILL "FREE-WHEEL" AND MUST BE ENGAGED AGAIN.



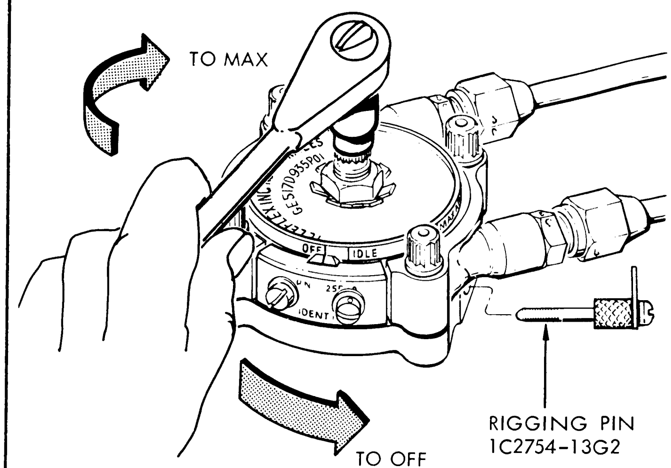
c POSITION THE CABLE BOX INDICATOR DIAL SO THAT THE **OFF** POSITION ALIGNS WITH THE REFERENCE MARK ON THE CABLE BOX VERNIER.

d HOLD THE SHAFT WITH THE ADAPTER WRENCH AND TORQUE THE LOCKNUT TO 30-40 LB-IN. DO NOT BEND THE TABWASHER AT THIS TIME.

4 MAIN FUEL CONTROL RIGGING PIN

a ROTATE THE INPUT SHAFT ON THE MAIN FUEL CONTROL FROM **OFF** TO **MAX**, CHECKING FOR FREEDOM OF MOVEMENT. RETURN THE SHAFT TO **OFF**, AGAINST THE STOP IN THE CONTROL.

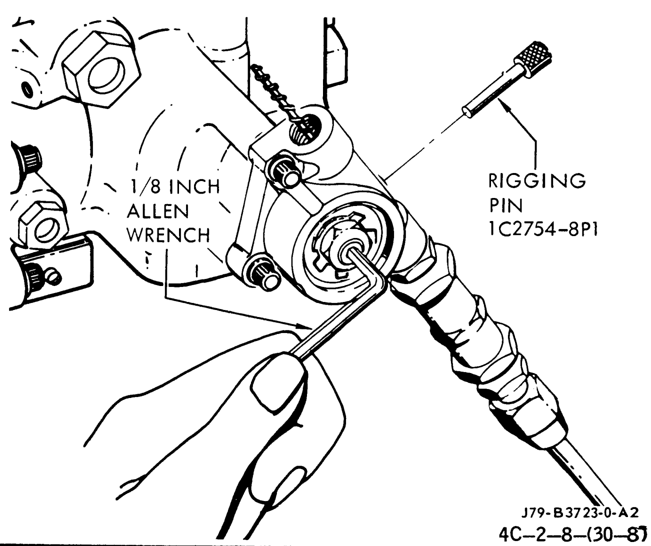
b THREAD THE RIGGING PIN, 1C2754-13G2, INTO THE RIGGING PORT. IF THE PIN IS PROPERLY ENGAGED, THE SHAFT WILL NOT ROTATE.



c IF NECESSARY, REPOSITION THE CABLE BOX VERNIER SO THAT THE REFERENCE MARK LINES UP WITH THE **OFF** POSITION ON THE INDICATOR DIAL. TORQUE THE SCREWS TO 13-16 LB-IN. DO NOT LOCKWIRE AT THIS TIME.

5 AFTERBURNER FUEL CONTROL SHAFT CLUTCH ENGAGEMENT

a ROTATE THE INPUT SHAFT ON THE AFTERBURNER FUEL CONTROL COUNTERCLOCKWISE TO THE STOP WITH AN ALLEN WRENCH. THEN ROTATE THE SHAFT SLOWLY CLOCKWISE UNTIL RIGGING PIN, 1C2754-8P1, CAN BE INSERTED INTO THE OPEN RIGGING PORT BELOW THE CABLE BOX.



4C-2-8-(30-8)

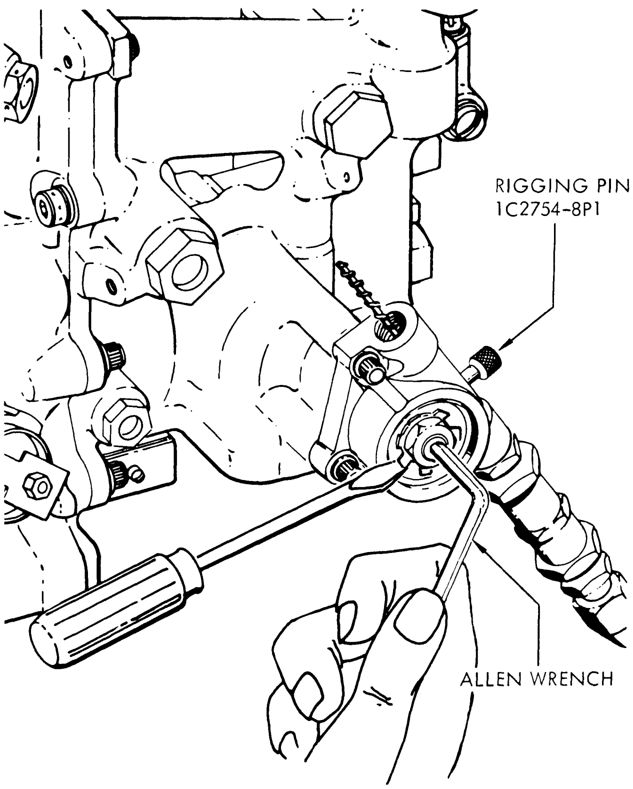
Figure 4-16. Throttle Input Linkage - AFTER T.O. 2J-J79-1217 (Sheet 8 of 14)

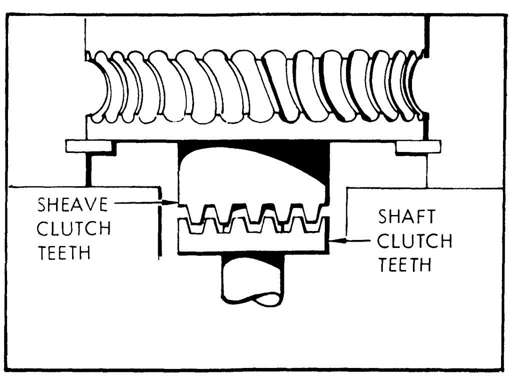
5

NOTE

IN THE FOLLOWING STEP, A SCREW-DRIVER MAY BE INSERTED UNDER THE LOCKNUT TO GENTLY PRY THE SHAFT OUTWARD TO ASSIST ENGAGEMENT.

b PULL THE INPUT SHAFT OUTWARD, UNTIL THERE IS CONTACT BETWEEN THE SHAFT AND CABLE BOX CLUTCH TEETH.



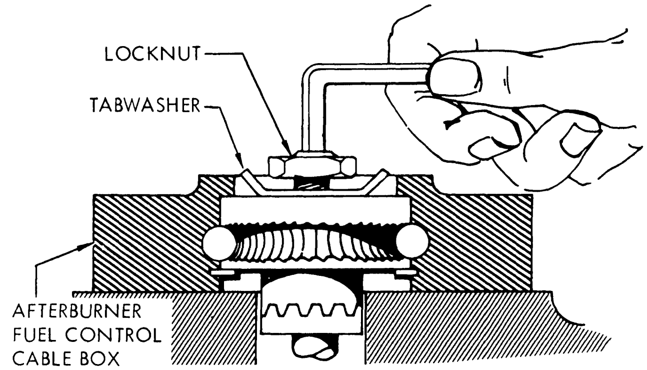


c HOLD THE INPUT SHAFT WITH THE ALLEN WRENCH, REMOVE THE RIGGING PIN, AND PULL THE INPUT SHAFT OUT COMPLETELY TO ENGAGE THE SHAFT AND CABLE BOX CLUTCH TEETH. IT MAY BE NECESSARY TO ROTATE THE INPUT SHAFT SLIGHTLY TO COMPLETE THE ENGAGEMENT.

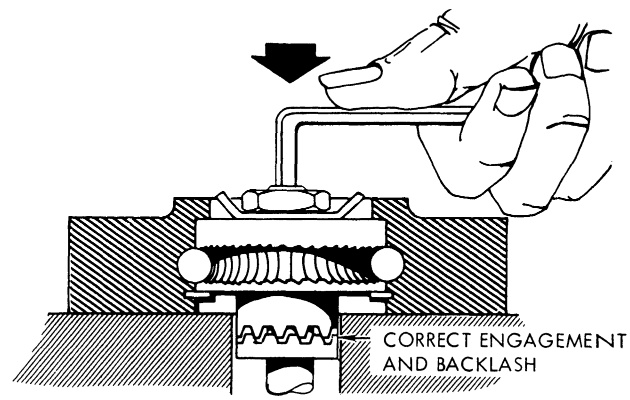
d TIGHTEN THE INPUT SHAFT LOCKNUT FINGERTIGHT.

6 CLUTCH ENGAGEMENT CHECK

a HOLD THE INPUT SHAFT WITH THE ALLEN WRENCH, MARK ONE FLAT ON THE LOCKNUT, AND LOOSEN THE LOCKNUT EXACTLY 1/2 TURN.



b PUSH THE SHAFT IN WITH THE ALLEN WRENCH AND TRY TO ROTATE THE SHAFT IN BOTH DIRECTIONS. IF THE SHAFT WILL NOT TURN MORE THAN THE CLUTCH TEETH BACKLASH PERMITS, THE ENGAGEMENT IS CORRECT. IF CLUTCH ENGAGEMENT IS NOT CORRECT, THE SHAFT WILL "FREE-WHEEL", AND MUST BE ENGAGED AGAIN.



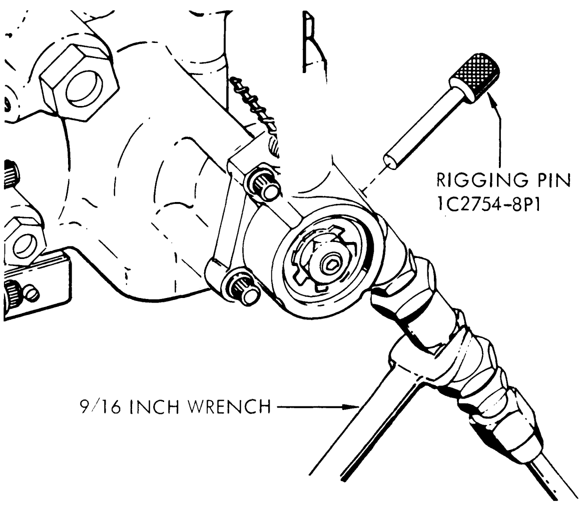
c VISUALLY CHECK THROUGH THE RIGGING PORT FOR PROPER CLUTCH ENGAGEMENT.

d HOLD THE SHAFT WITH THE ALLEN WRENCH AND TORQUE THE LOCKNUT TO 30-40 LB-IN. DO NOT BEND THE TABWASHER AT THIS TIME.

J79-B3724-0-A2
4C-2-8-(30-9)

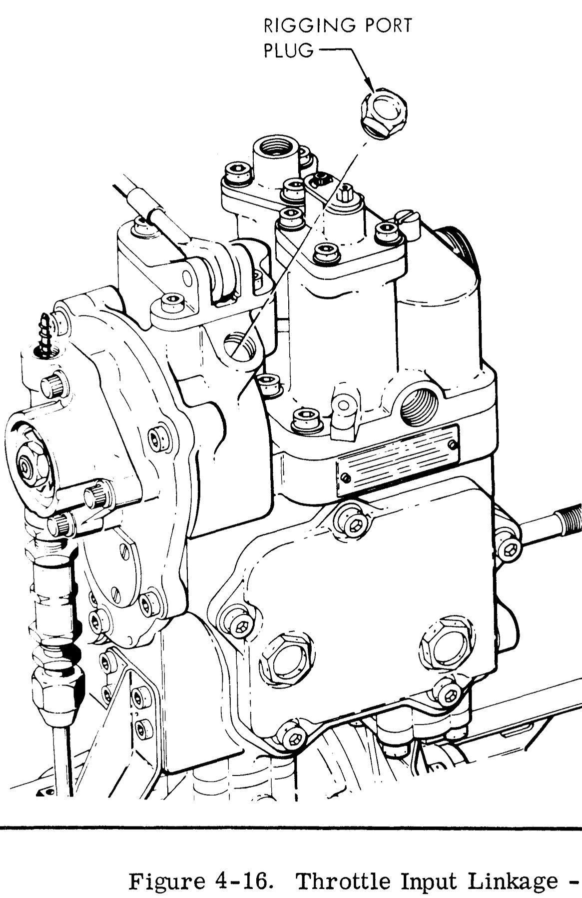
Figure 4-16. Throttle Input Linkage - AFTER T.O. 2J-J79-1217 (Sheet 9 of 14)

6 d INSERT THE RIGGING PIN INTO THE RIGGING PORT. IF THE PIN WILL NOT FIT, ADJUST THE CABLE LENGTH AS NECESSARY BY TURNING THE MICRO-ADJUST UNIT WITH A 9/16 INCH WRENCH. THE RIGGING PIN MUST SLIDE FREELY INTO THE SHAFT CAM RIGGING SLOT. REMOVE THE RIGGING PIN.



7 NOZZLE AREA CONTROL SHAFT CLUTCH ENGAGEMENT

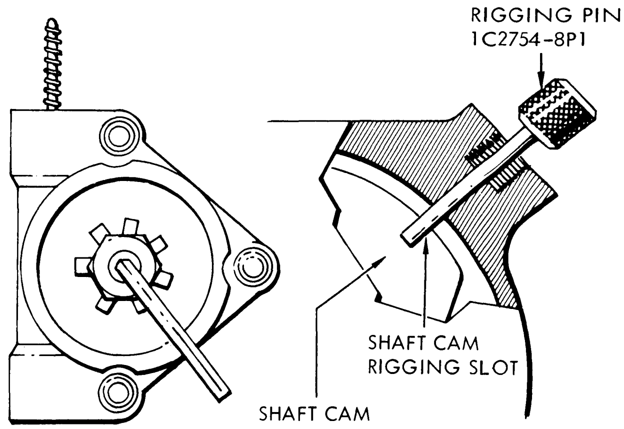
a REMOVE THE PLUG FROM THE RIGGING PORT ON THE NOZZLE AREA CONTROL.

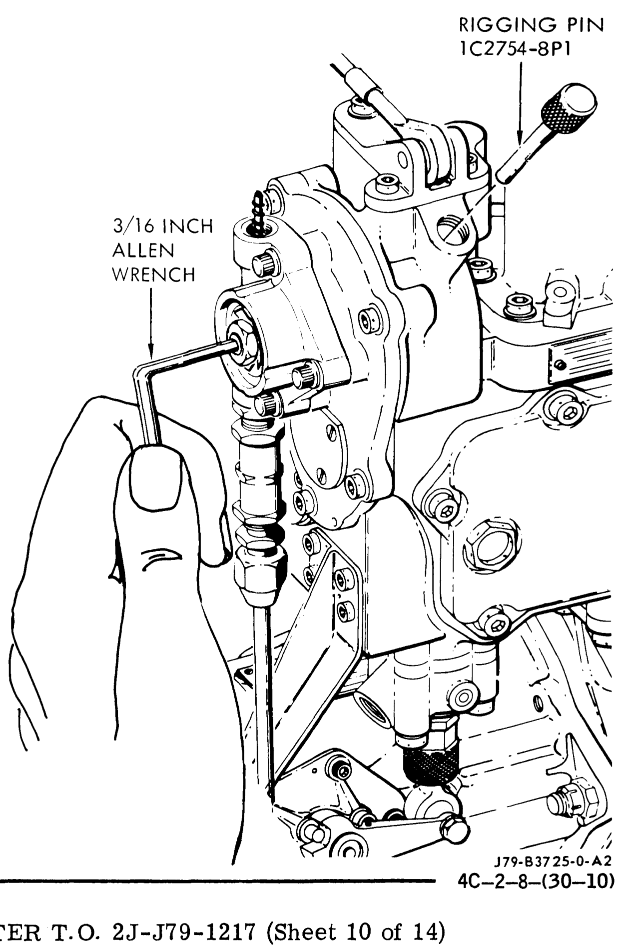


NOTE

IN THE FOLLOWING STEP, THE INPUT SHAFT ON THE NOZZLE AREA CONTROL CAN BE ROTATED 360 DEGREES WITHOUT DAMAGE TO THE CONTROL. THE SHAFT WILL NOT ROTATE IN EITHER DIRECTION WHEN THE RIGGING PIN IS INSTALLED PROPERLY.

b ROTATE THE NOZZLE AREA CONTROL INPUT SHAFT WITH AN ALLEN WRENCH UNTIL RIGGING PIN, 1C2754-8P1, FITS INTO THE SHAFT CAM RIGGING SLOT.





4C-2-8-(30-10)

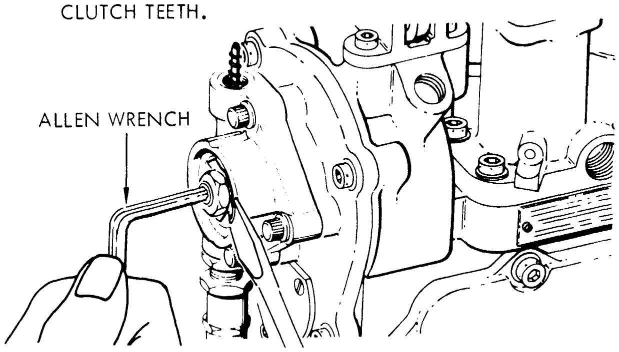
Figure 4-16. Throttle Input Linkage - AFTER T.O. 2J-J79-1217 (Sheet 10 of 14)

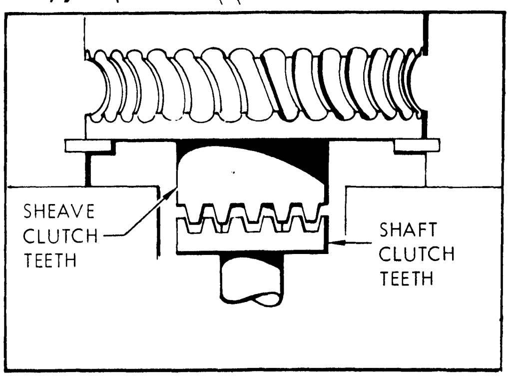
7

NOTE

IN THE FOLLOWING STEP, A SCREW-DRIVER MAY BE INSERTED UNDER THE LOCKNUT TO GENTLY PRY THE SHAFT OUTWARD TO ASSIST ENGAGEMENT.

c PULL THE INPUT SHAFT OUTWARD, UNTIL THERE IS CONTACT BETWEEN THE SHAFT AND CABLE BOX CLUTCH TEETH.



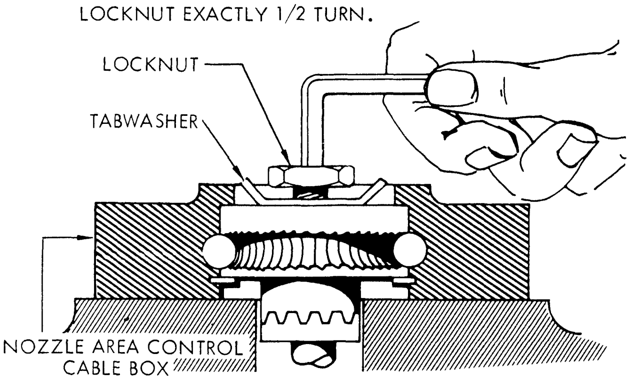


d HOLD THE INPUT SHAFT WITH THE ALLEN WRENCH, REMOVE THE RIGGING PIN, AND PULL THE INPUT SHAFT OUT COMPLETELY TO ENGAGE THE SHAFT AND CABLE BOX CLUTCH TEETH. IT MAY BE NECESSARY TO ROTATE THE INPUT SHAFT SLIGHTLY TO COMPLETE THE ENGAGEMENT.

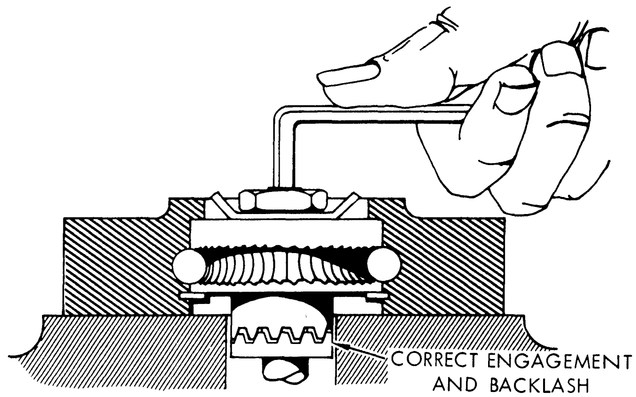
e TIGHTEN THE LOCKNUT FINGERTIGHT.

8 CLUTCH ENGAGEMENT CHECK

a HOLD THE INPUT SHAFT WITH THE ALLEN WRENCH, MARK ONE FLAT ON THE LOCKNUT AND LOOSEN THE LOCKNUT EXACTLY 1/2 TURN.

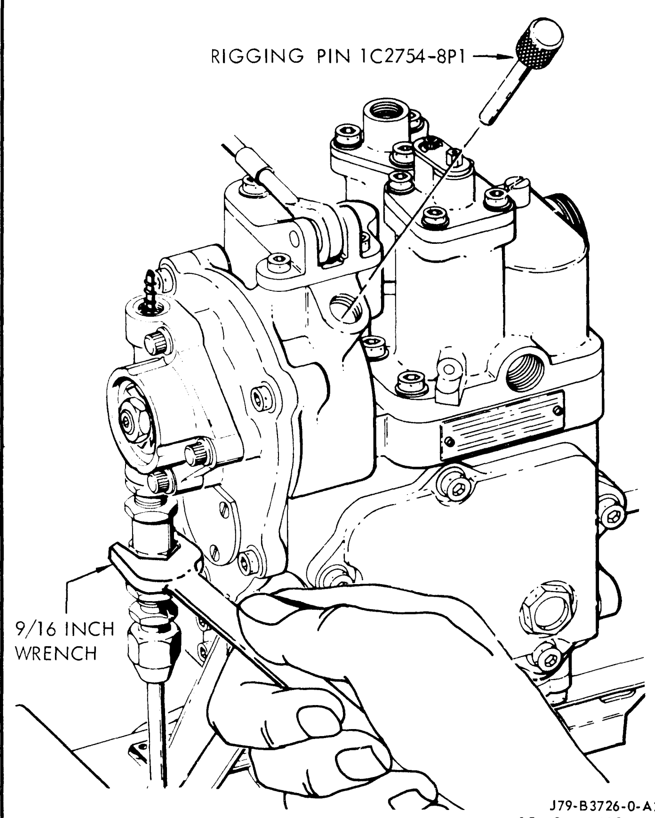


b PUSH THE SHAFT IN WITH THE ALLEN WRENCH AND TRY TO ROTATE THE SHAFT IN BOTH DIRECTIONS. IF THE SHAFT WILL NOT TURN MORE THAN THE CLUTCH TEETH BACKLASH PERMITS, THE ENGAGEMENT IS CORRECT. IF CLUTCH ENGAGEMENT IS NOT CORRECT, THE SHAFT WILL "FREE-WHEEL", AND MUST BE ENGAGED AGAIN.



c HOLD THE SHAFT WITH THE ALLEN WRENCH AND TORQUE THE LOCKNUT TO 30-40 LB-IN. DO NOT BEND THE TABWASHER AT THIS TIME.

d INSERT THE RIGGING PIN INTO THE RIGGING PORT. IF THE PIN WILL NOT FIT, ADJUST THE CABLE LENGTH AS NECESSARY BY TURNING THE MICRO-ADJUST UNIT WITH A 9/16 INCH WRENCH. THE RIGGING PIN MUST SLIDE FREELY INTO THE SHAFT CAM RIGGING SLOT. REMOVE THE RIGGING PIN.



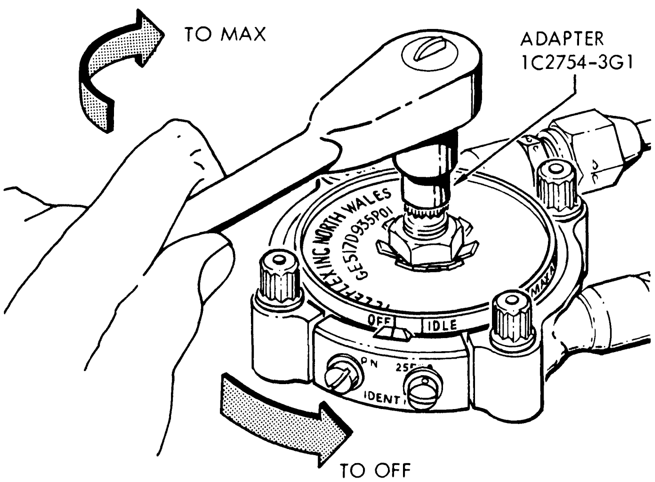
4C-2-8-(30-11)

Figure 4-16. Throttle Input Linkage - AFTER T.O. 2J-J79-1217 (Sheet 11 of 14)

9 RIGGING CHECKS

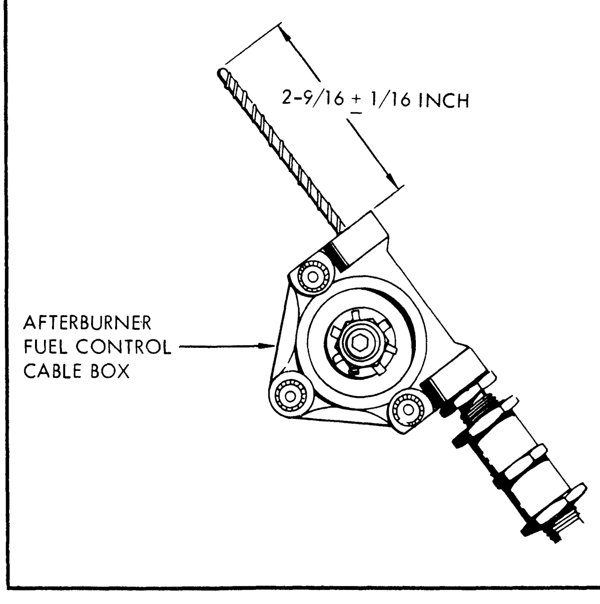
a REMOVE THE RIGGING PIN FROM THE MAIN FUEL CONTROL.

b ROTATE THE MAIN FUEL CONTROL THROTTLE SHAFT THROUGHOUT ITS FULL TRAVEL, **OFF** TO **MAX**. DETERMINE THAT MOVEMENT IS FREE, WITHOUT BINDING.

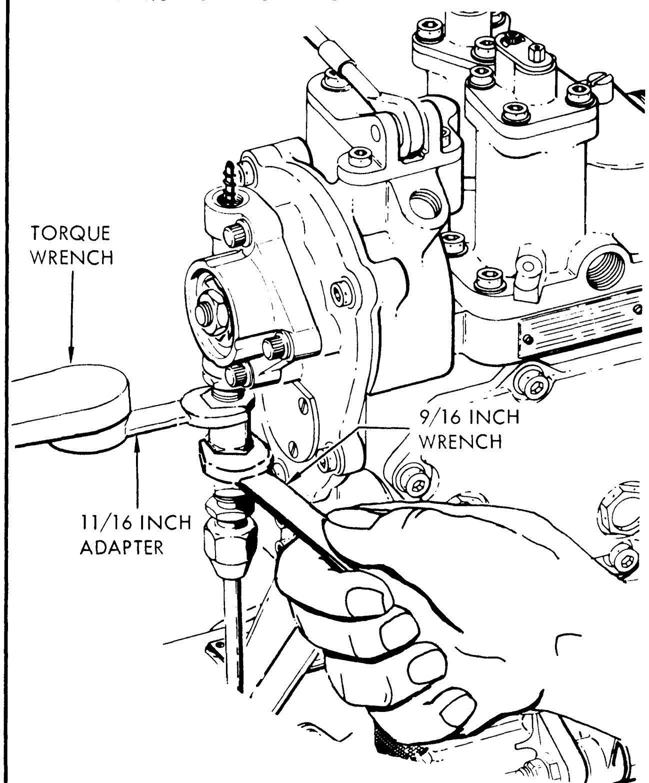


c HOLD THE MAIN FUEL CONTROL AT **OFF**, AND TRY THE RIGGING PIN IN BOTH THE AFTERBURNER FUEL CONTROL AND NOZZLE AREA CONTROL AGAIN. MAKE ADJUSTMENTS AS NECESSARY WITH THE MICRO-ADJUST UNITS UNTIL THE RIGGING PIN SLIDES FREELY INTO THE SHAFT CAM RIGGING SLOTS. REMOVE THE RIGGING PIN.

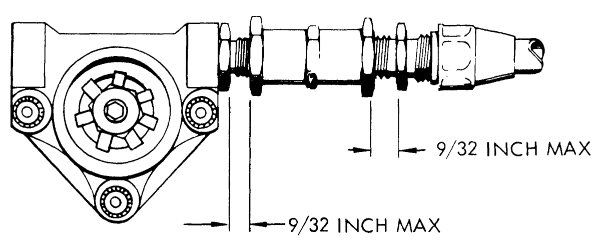
d HOLD THE MAIN FUEL CONTROL AT THE **OFF** POSITION, CHECK THAT THE CABLE EXTENDS 2-9/16 ± 1/16 INCHES PAST THE CABLE BOX ON THE AFTERBURNER FUEL CONTROL.



e TORQUE THE TWO MICRO-ADJUST UNIT JAM NUTS TO 50-60 LB-IN. DO NOT ALLOW THE COUPLINGS ON THE MICRO-ADJUST UNITS TO ROTATE WHILE TORQUING THE JAM NUTS.



f MEASURE THE DISTANCE BETWEEN EACH JAM NUT AND THE CORRESPONDING CONNECTOR HEX. IF THE MEASUREMENT EXCEEDS 9/32 INCH, POSITIVE ENGAGEMENT OF THE CONNECTORS IN THE COUPLINGS IS NOT CORRECT; RE-RIG THE SYSTEM.



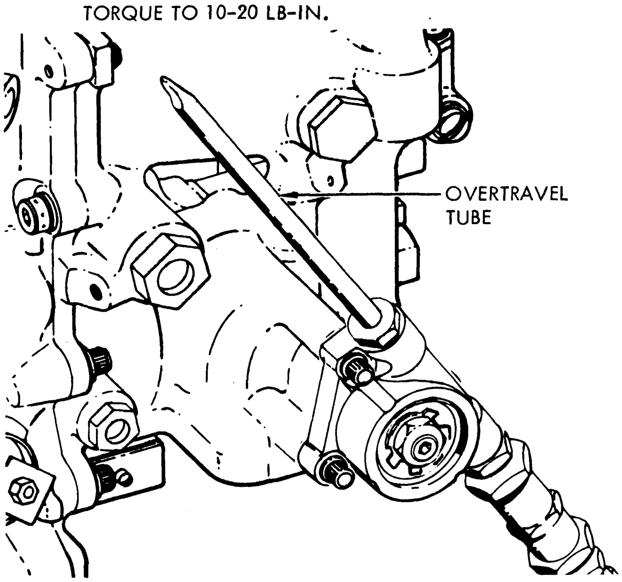
J79-B3727-0-A2

4C-2-8-(30-12)

Figure 4-16. Throttle Input Linkage - AFTER T.O. 2J-J79-1217 (Sheet 12 of 14)

10 FINAL INSTALLATION

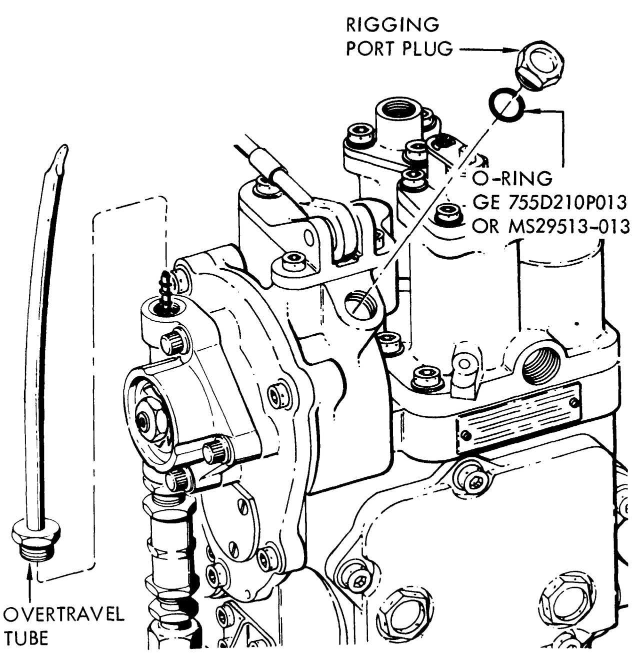
a INSTALL THE STRAIGHT OVERTRAVEL TUBE IN THE CABLE BOX ON THE AFTERBURNER FUEL CONTROL; TORQUE TO 10-20 LB-IN.



b INSTALL THE CURVED OVERTRAVEL TUBE IN THE CABLE BOX ON THE NOZZLE AREA CONTROL; TORQUE TO 10-20 LB-IN.

c ROTATE THE MAIN FUEL CONTROL THROTTLE SHAFT THROUGHOUT ITS FULL TRAVEL, **OFF** TO **MAX.** DETERMINE THAT MOVEMENT IS FREE, WITHOUT BINDING.

d ASSEMBLE A NEW O-RING (GE 755D210P013) ON THE RIGGING PORT PLUG; INSTALL IN THE RIGGING PORT ON THE NOZZLE AREA CONTROL; TORQUE TO 20-30 LB-IN. AND LOCKWIRE.



11 SECURING THE SYSTEM

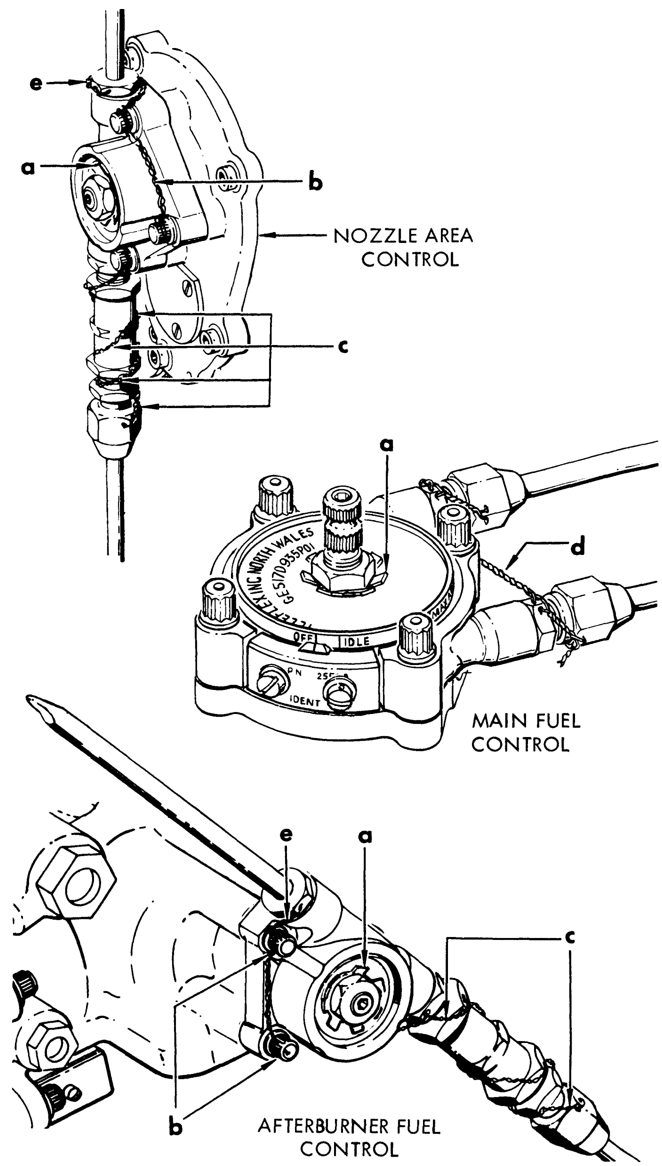
a BEND A TAB ON THE TABWASHER AGAINST A LOCKNUT FLAT ON EACH CONTROL SHAFT LOCKNUT.

b LOCKWIRE THE TWO UPPER MOUNTING BOLTS ON THE AFTERBURNER FUEL AND NOZZLE AREA CONTROL CABLE BOXES.

c LOCKWIRE EACH CONDUIT COUPLING NUT TO THE MICRO-ADJUST UNIT AND THEN TO THE NEAREST CABLE BOX MOUNTING BOLT.

d LOCKWIRE EACH CONDUIT COUPLING NUT TO THE CABLE BOX ADAPTERS ON THE MAIN FUEL CONTROL.

e LOCKWIRE EACH OVERTRAVEL TUBE TO THE NEAREST CABLE BOX MOUNTING BOLT.



4C-2-8-(30-13)A

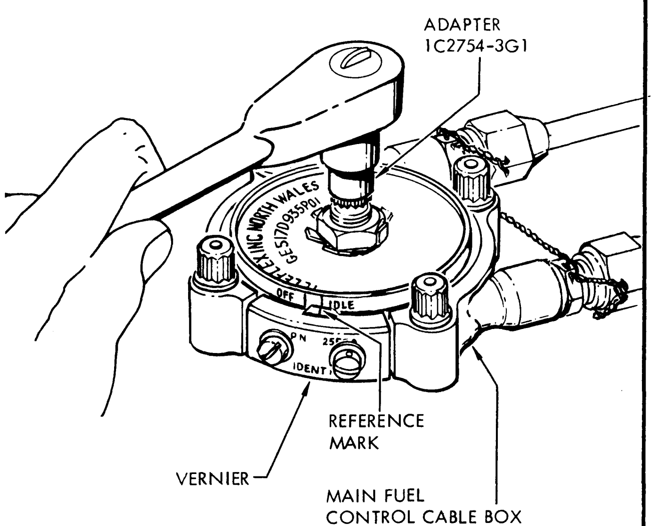
Figure 4-16. Throttle Input Linkage - AFTER T.O. 2J-J79-1217 (Sheet 13 of 14)

12 VERNIER CHECK AT IDLE

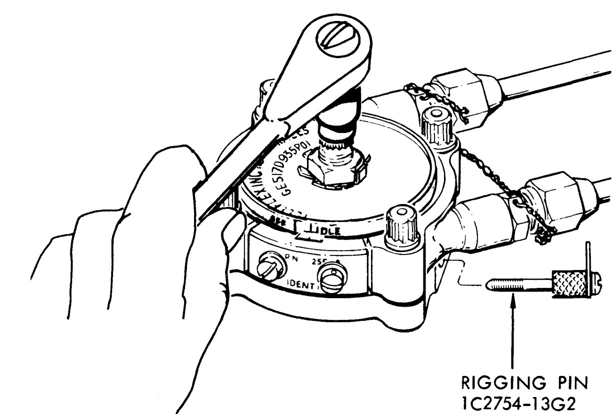
NOTE

THE FOLLOWING STEPS PROVIDE A CHECK FOR CORRECT ALIGNMENT OF THE INDICATOR DIAL AND THE VERNIER AT **IDLE** WHICH IS THE POSITION USED FOR AIRFRAME TO ENGINE RIGGING.

a ROTATE THE INPUT SHAFT ON THE MAIN FUEL CONTROL SO THAT THE **IDLE** POSITION ALIGNS WITH THE REFERENCE MARK ON THE CABLE BOX VERNIER.

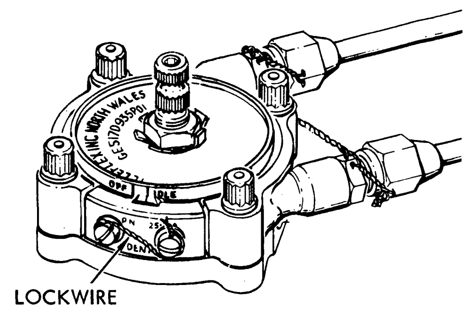


b THREAD THE RIGGING PIN, 1C2754-13G2, INTO THE RIGGING PORT. IF THE PIN IS PROPERLY ENGAGED. THE SHAFT WILL NOT ROTATE.



c CHECK THE ALIGNMENT OF THE INDICATOR DIAL AND THE VERNIER REFERENCE MARK AT THE **IDLE** POSITION.

d IF NECESSARY, REPOSITION THE CABLE BOX VERNIER SO THAT THE REFERENCE MARK LINES UP WITH THE **IDLE** POSITION ON THE INDICATOR DIAL. TORQUE THE SCREWS TO 13-16 LB-IN. AND LOCKWIRE.



NOTE

IF IT IS NECESSARY TO ADJUST THE CABLE BOX VERNIER AT **IDLE**, THE INDICATOR DIAL AND VERNIER MAY NOT ALIGN PRECISELY AT **OFF** OR OTHER POSITIONS. DO NOT REPOSITION THE VERNIER AFTER THIS INITIAL ADJUSTMENT. THE RIGGING PIN WILL THEN HAVE TO BE USED TO DETERMINE THE **OFF, MIL, MIN A/B** AND **MAX A/B** POSITIONS.

J79-B3834-0-A2A

4C-2-8-(30-14)

Figure 4-16. Throttle Input Linkage - AFTER T.O. 2J-J79-1217 (Sheet 14 of 14)

4-115. AIRFRAME POWER PLANT CONTROL SYSTEM RIGGING.

CAUTION

When problems are experienced in rigging, measure the clearance between the torque booster valve stop screws and the output lever tang. Rotate input lever against one of the valve stop screws; using a feeler gage measure the total distance between the other valve stop screw and the output lever tang. If this total measurement exceeds 0.080 inch, the torque booster should be returned to overhaul.

4-116. The purpose of this rigging procedure is to coordinate the airframe power plant control system with the engine control system. Rigging of the airframe power plant control system is required whenever maintenance is performed on the system such as throttle quadrant or cable removal. If engine control box torque shaft is disconnected from main fuel control crossover shaft to facilitate other maintenance such as engine removal and installation, connect torque shaft by performing following:

a. Steps Q, R, S and U thru X of pre—rigging procedure, figure 4—17.

b. Airframe Power Plant Control System Rigging Check — Engines Operating. Refer to paragraph 2—54.

NOTE

The airframe power plant control systems are sensitive systems and require careful and knowledgeable maintenance at all times. A skilled, careful, and experienced mechanic is required to rig and maintain the airframe power plant control systems.

4-117. AIRFRAME POWER PLANT CONTROL SYSTEM PRERIGGING.

4-118. Tools and Equipment.

Safety strut, auxiliary air door

4-119. Procedure. See figure 4—17.

4-120. AIRFRAME POWER PLANT CONTROL SYSTEM WET RIGGING (PREFERRED).

4-121. Tools and Equipment.

Pin, rig
Screwdriver, throttle stop adjusting
Pressurizing unit, variable vane
Wrench, torque, 0 to 100 inch—pounds

4-122. Materials.

Lockwire, MS20995NC32
Pin, cotter, MS24665—134
Pin, cotter, MS24665—149

4-123. Manpower Requirements.

a. Three men required.

4-124. Procedure. See figure 4—18.

4-125. AIRFRAME POWER PLANT CONTROL SYSTEM DRY RIGGING (ALTERNATE).

4-126. Tools and Equipment.

Safety strut, auxiliary air door
Pin, rig
Screwdriver, throttle stop adjusting
Wrench, torque, 0 to 100 inch—pounds

4-127. Materials.

Lockwire, MS20995NC32
Pin, cotter, MS24665—134
Pin, cotter, MS24665—149

4-128. Manpower Requirements.

a. Three men required.

4-129. Procedure. See figure 4—19.

4-129A. AFT COCKPIT THROTTLE RIGGING.

4-129B. Tools and Equipment.

Tool, throttle rig

4-129C. Manpower Requirements.

a. Two men required.

4-129D. Procedure. See figure 4—19A.

4-129E. THROTTLE CUTOFF SWITCH ADJUSTMENT.

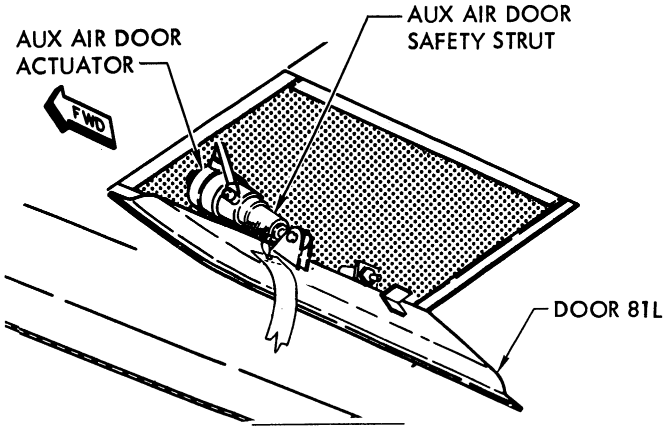
4-129F. Tools and Equipment.

Multimeter

4-129G. Procedure. See figure 4—19B.

4-129H. AIRFRAME POWER PLANT CONTROL SYSTEM RIGGING CHECK — ENGINES OPERATING. An airframe power plant control system rigging check — engines operating must be performed each time system is rigged. Refer to paragraph 2—54.

1 ACCESS



WARNING

TO PREVENT PERSONNEL INJURY ASSURE SAFETY STRUT IS INSTALLED ON DOORS 81L AND R.

A INSTALL AUXILIARY AIR DOOR SAFETY STRUT 32E050034-1.

B DISCONNECT ACTUATOR FROM DOOR 81 BY REMOVING BOLT.

C OPEN DOOR 82L OR R.

D REMOVE DOOR 9L.

E OPEN DOOR 83L OR R.

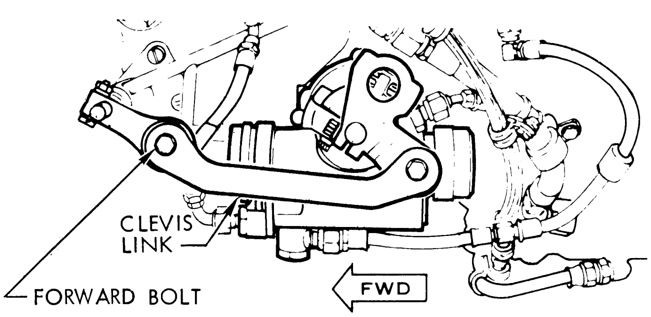
2 PROCEDURE

CAUTION

ASSURE ELECTRICAL POWER IS DISCONNECTED FROM AIRCRAFT.

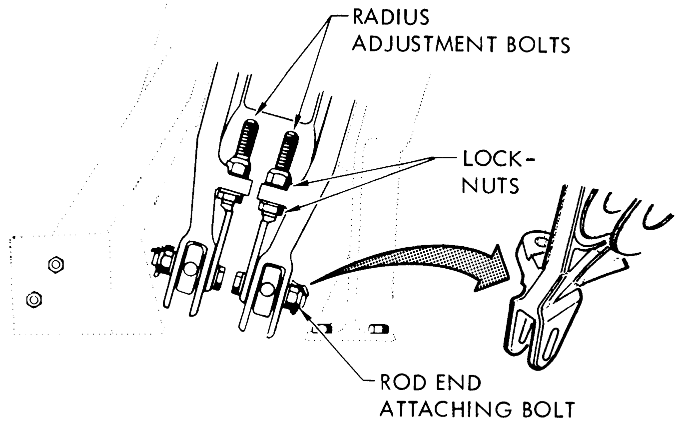
A ASCERTAIN THAT SYSTEM MEETS REQUIREMENTS OF AIRFRAME POWER PLANT CONTROL SYSTEM WEAR CHECK. REFER TO SECTION II.

B PERFORM AIRFRAME POWER PLANT CONTROL SYSTEM FRICTION CHECK. REFER TO SECTION II.



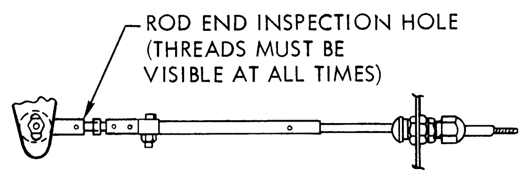
C ASSURE FORWARD COCKPIT THROTTLE LEVER TRAVEL IS NOT RESTRICTED BY AFT COCKPIT THROTTLE LEVERS HITTING THE QUADRANT AND/OR CONSOLE PANELS AT OFF OR MAX AB POSITIONS. TELESCOPIC UNIT OUTER SLIDE DOES NOT CONTACT SWIVEL NUT.

D REMOVE FORWARD BOLT FROM CLEVIS LINK.



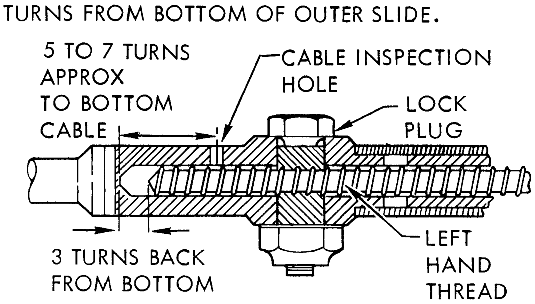
E CHECK THAT ROD END ATTACHING BOLT IS CENTERED IN RADIUS ADJUSTMENT SLOT. LOOSEN ROD END ATTACHING BOLT IF REQUIRED.

F ASSURE APPROXIMATELY THREE THREADS ARE VISIBLE AT ROD END.



G ASSURE THREADS ARE VISIBLE IN ROD END INSPECTION HOLE.

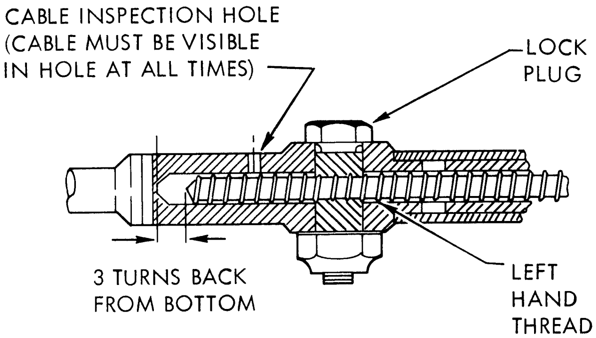
H ASSURE CABLE IS BACKED OUT APPROXIMATELY THREE TURNS FROM BOTTOM OF OUTER SLIDE.



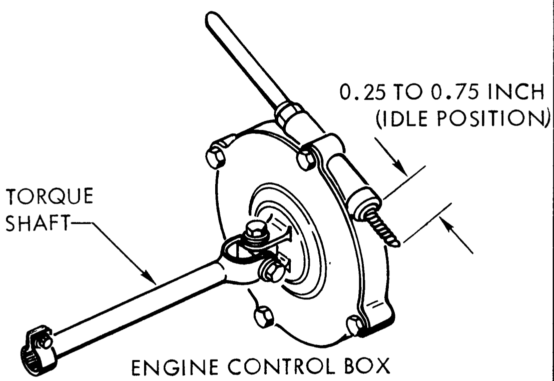
MAJOR CHANGE

4C-2-8-(146-1)A

Figure 4-17. Airframe Power Plant Control System Prerigging (Sheet 1 of 3)



J ASSURE CABLE IS VISIBLE IN CABLE INSPECTION HOLE



K POSITION FORWARD COCKPIT THROTTLE LEVER TO OFF, AND REMOVE OVERTRAVEL TUBE FROM ENGINE CONTROL BOX.

L POSITION FORWARD COCKPIT THROTTLE LEVER TO IDLE AND APPLY FRICTION LEVER.

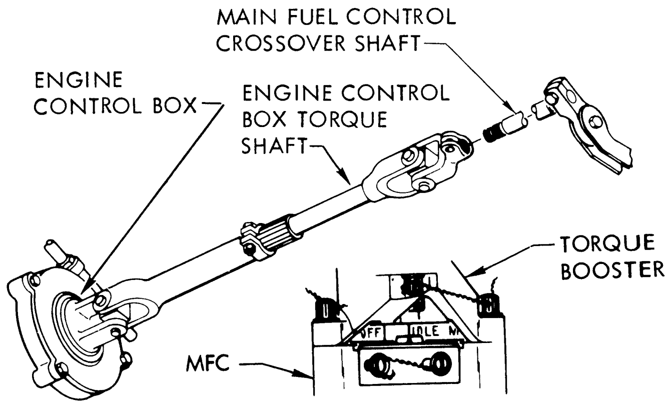
M MEASURE CABLE EXTENDING BEYOND OUTLET OF ENGINE CONTROL BOX. CABLE MUST EXTEND 0.25 TO 0.75 INCHES BEYOND OUTLET OF ENGINE CONTROL BOX. WHEN CABLE DOES NOT EXTEND PROPER AMOUNT, REPLACE CABLE WITH ONE OF THE PROPER LENGTH. INSTALL OVERTRAVEL TUBE. TORQUE NUT 40 TO 60 INCH-POUNDS AND LOCKWIRE.

N CYCLE FORWARD COCKPIT THROTTLE LEVER BETWEEN IDLE AND MIL AT LEAST 10 TIMES TO REMOVE ANY POSSIBLE CABLE TWIST.

O DISCONNECT ENGINE CONTROL BOX FROM MFC CROSSOVER SHAFT.

P ASSEMBLE AND REINSTALL FORWARD BOLT IN CLEVIS LINK.

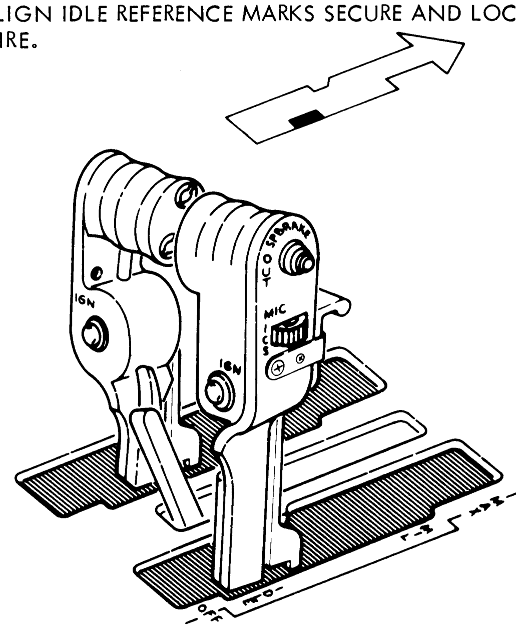
MAJOR CHANGE



CAUTION

WHEN USING MAIN FUEL CONTROL VERNIER FOR THROTTLE RIGGING, ALWAYS VIEW VERNIER FROM APPROXIMATELY SAME EYE LEVEL (VIEWING ANGLE ESTABLISHED THROUGH CENTERLINE OF SHAFT) TO OBTAIN CONSISTENT AND ACCURATE READING.

Q ROTATE TORQUE BOOSTER INPUT LEVER FORWARD TO POSITION MFC AT IDLE. INSTALL RIG PIN IN MFC. IF MFC VERNIER IS INSTALLED VERIFY ALIGNMENT OF IDLE REFERENCE MARKS. IF IDLE REFERENCE MARKS DO NOT ALIGN REMOVE SAFETY WIRE AND LOOSEN VERNIER MOUNTING SCREWS. ALIGN IDLE REFERENCE MARKS SECURE AND LOCKWIRE.



NOTE

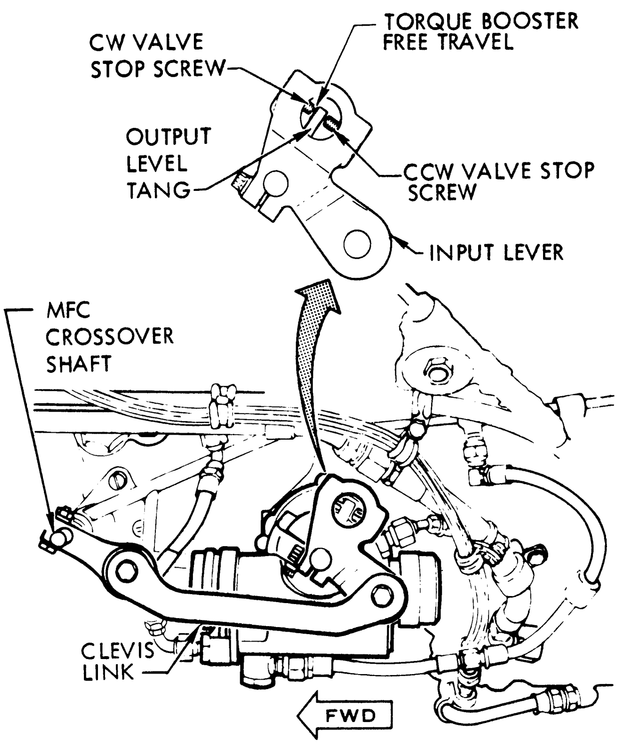
ALWAYS ADVANCE THROTTLE LEVER TOWARDS MIL AND RETARD TO IDLE STOP.
MOVE INPUT LEVER AFT FOR OFF AND FORWARD FOR MAX AB.

R POSITION FORWARD COCKPIT THROTTLE LEVER AT IDLE.

S PLACE THROTTLE FRICTION LEVER ON TO HOLD THROTTLE LEVER(S) IN IDLE.

4C-2-8-(146-2)A

Figure 4-17. Airframe Power Plant Control System Prerigging (Sheet 2 of 3)



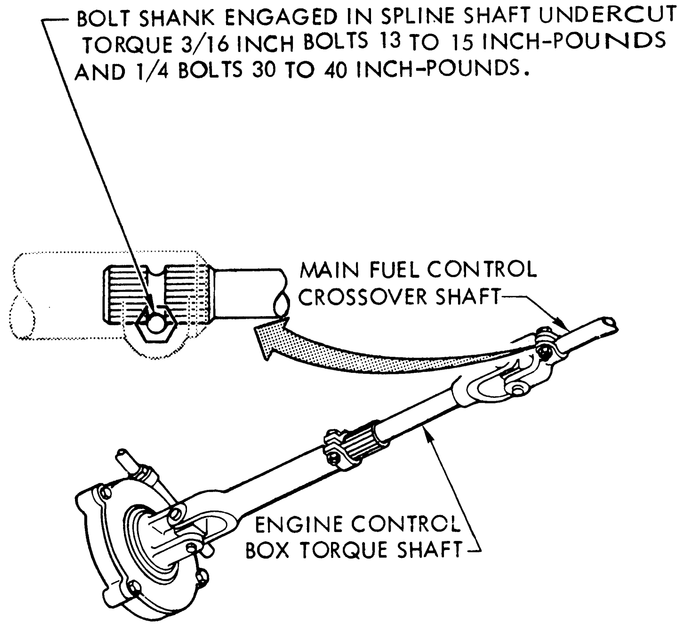
T IF DRY RIGGING PROCEDURE (ALTERNATE) IS TO BE UTILIZED, PROCEED DIRECTLY TO IT AT THIS POINT.

U ROTATE TORQUE BOOSTER INPUT LEVER THROUGHOUT RANGE OF FREE TRAVEL (STOP TO STOP FREE PLAY) UNTIL TORQUE SHAFT SPLINES MATE WITH MFC CROSSOVER SHAFT SPLINES.

NOTE

DO NOT ATTEMPT TO ADJUST INPUT LEVER VALVE STOP SCREWS.

V WHEN SPLINE ALIGNMENT CANNOT BE OBTAINED, ADJUSTMENT OF TELESCOPIC UNIT ROD END IS REQUIRED. REFER TO STEP 4 OF WET RIGGING PROCEDURE.



WARNING

TO PREVENT LOSS OF THROTTLE CONTROL, DO NOT INSTALL 3/16 INCH BOLTS IN TORQUE SHAFTS HAVING 1/4 INCH HOLES.

NOTE

SELF RETAINING BOLT IS USED TO CONNECT TORQUE SHAFT TO MFC CROSSOVER SHAFT AND END OF TORQUE SHAFT IS PAINTED BLUE.

W CONNECT TORQUE SHAFT TO MFC CROSSOVER SHAFT AND INSTALL BOLT BEING SURE BOLT ENGAGES UNDERCUT IN CROSSOVER SHAFT. USE WASHERS AS REQUIRED TO ASSURE NUT DOES NOT BOTTOM OUT. TORQUE BOLT AND INSTALL COTTER PIN.

X REMOVE RIG PIN FROM MFC.

Y PROCEED WITH RIGGING PROCEDURE. (WET RIGGING PREFERRED).

4C-2-8-(146—3)B

Figure 4-17. Airframe Power Plant Control System Prerigging (Sheet 3 of 3)

NOTE

THIS PROCEDURE UTILIZES THE 53E390214-1 TORQUE BOOSTER PRESSURIZATION UNIT. IF THE 1C3568-G1 UNIT IS USED AS AN ALTERNATE, REFER TO TO 33D4-6-209-1 FOR OPERATING INSTRUCTIONS.

1 CONNECT TORQUE BOOSTER PRESSURIZATION UNIT TO ENGINE TORQUE BOOSTER

NOTE

THE 53E390214-1 PRESSURIZATION UNIT IS CAPABLE OF PRESSURIZING LEFT AND RIGHT ENGINE TORQUE BOOSTERS SIMULTANEOUSLY. IF BOTH ENGINES ARE TO BE CHECKED AT SAME TIME, CONNECT REMAINING SYSTEM TO OPPOSITE ENGINE BY REPEATING STEPS C THRU F.

A CONNECT EXTERNAL GROUND WIRE TO SAFETY GROUND POST.

B ENSURE DRAIN VALVE IS CLOSED AND FILL RESERVOIR TO FULL MARK WITH JP-4 OR JP-5 FUEL.

C DISCONNECT PRESSURE AND RETURN HOSES FROM TORQUE BOOSTER AND INSTALL PROTECTIVE COVERS ON HOSES.

D CONNECT LONG PRESSURE HOSE TO PRESSURE FITTING ON PRESSURIZATION UNIT, AND SHORT PRESSURE HOSE TO PRESSURE FITTING ON TORQUE BOOSTER.

E CONNECT LONG RETURN HOSE TO RETURN FITTING ON PRESSURIZATION UNIT, AND SHORT RETURN HOSE TO RETURN FITTING ON TORQUE BOOSTER.

F COUPLE PRESSURE AND RETURN HOSES BY CONNECTING TWO QUICK DISCONNECT FITTINGS.

G POSITION POWER SWITCH TO OFF POSITION.

H CONNECT ELECTRICAL POWER CORD TO POWER INPUT RECEPTACLE AND OTHER END TO EXTERNAL POWER SOURCE OF 115VAC (50 TO 60 HZ, SINGLE PHASE).

J CLOSE SYSTEM 1 AND 2 REGULATOR VALVES.

NOTE

THE 53E390214-1 PRESSURIZATION UNIT INCORPORATES TWO SAFETY CUTOFF SWITCHES, A LOW LEVEL RESERVOIR SWITCH AND A HI-TEMP FUEL SWITCH. THESE SWITCHES PREVENT OPERATION IF RESERVOIR FUEL IS LOW OR IF RESERVOIR FUEL TEMPERATURE EXCEEDS 180°F. ADDING OF FUEL TO RESERVOIR OR ALLOWING COOLDOWN PERIOD MAY BE REQUIRED IF SHUTDOWN OCCURS.

K POSITION POWER SWITCH TO ON AND ENSURE PUMP-OUTPUT PRESSURE GAGE INDICATES A MINIMUM OF 150PSI.

L OPEN APPLICABLE SYSTEM REGULATOR VALVE TO FULL OPEN POSITION.

MAJOR CHANGE

4C-2-8-(141-1)C

Figure 4-18. Airframe Power Plant Control System Wet Rigging (Preferred) (Sheet 1 of 6)

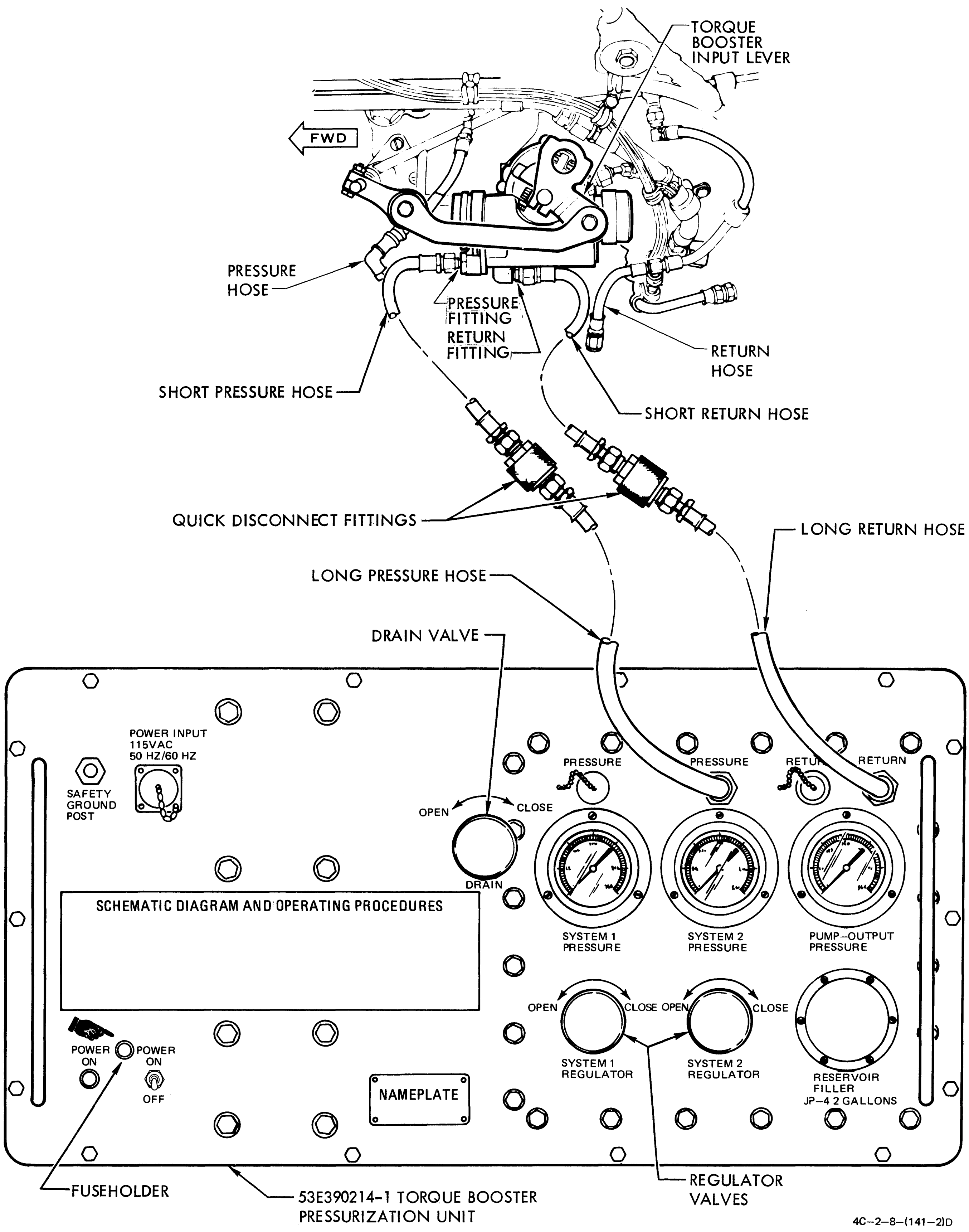


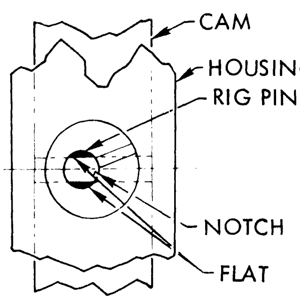
Figure 4-18. Airframe Power Plant Control System Wet Rigging (Preferred) (Sheet 2 of 6)

2 CAM NOTCH TO THROTTLE QUADRANT ADJUSTMENT

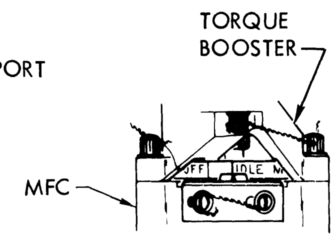
CAUTION

TO PREVENT MAIN FUEL CONTROL DAMAGE DO NOT PRESSURIZE TORQUE BOOSTER WITH RIG PIN INSTALLED.

A POSITION FORWARD COCKPIT THROTTLE LEVER TO IDLE AND OBSERVE FOLLOWING:



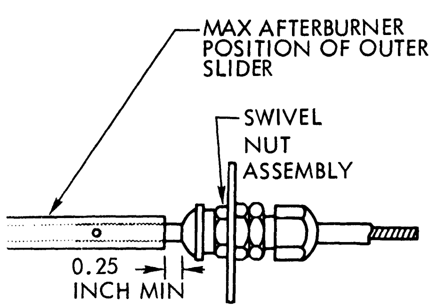
FUEL CONTROL CAM AT IDLE.



MFC VERNIER IDLE REFERENCE MARKS ALIGNED.

1. MFC IDLE CAM NOTCH, CENTERED IN RIG PIN PORT, OR MFC VERNIER IDLE REFERENCE MARKS ALIGNED.
2. IF IDLE ALIGNMENT IS IMPROPER ADJUST TELESCOPIC UNIT ROD END. REFER TO STEP 4, TELESCOPIC UNIT ROD END ADJUSTMENT.

B POSITION FORWARD COCKPIT THROTTLE LEVER TO MAX AB AND OBSERVE FOLLOWING:



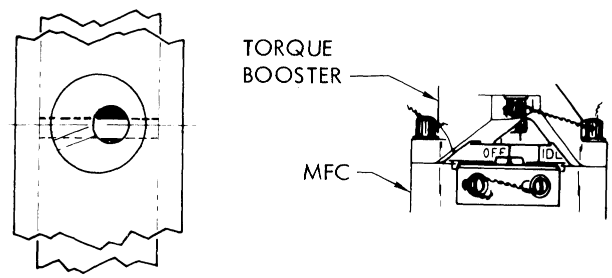
1. CHECK FORWARD COCKPIT THROTTLE TELESCOPIC UNIT OUTER SLIDER FOR CLEARANCE AT SWIVEL NUT.
2. BOTH COCKPIT THROTTLE LEVERS MUST NOT CONTACT QUADRANT STRUCTURE BEFORE MAXIMUM TRAVEL STOP IN MFC IS CONTACTED.

NOTE

WHEN COCKPIT THROTTLE LEVER WILL NOT SHIFT INBOARD OR OUTBOARD, LOOSEN CENTER SHIFT STOP PLATE AND REPOSITION. DO NOT ADJUST UNTIL AFTER MILITARY STOP PLATE IS ADJUSTED.

3. WITH BOTH THROTTLES AT MAX AB, LEVERS SHOULD BE ALIGNED WITHIN 1/4 INCH IF PRESCRIBED WEAR CHECKS AND PRE-RIG PROCEDURES HAVE BEEN ADHERED TO.

C POSITION FORWARD COCKPIT THROTTLE LEVER TO OFF AND OBSERVE THE FOLLOWING; IF THESE CONDITIONS ARE NOT MET, REACCOMPLISH PRE-RIG CHECKS.



1. MFC OFF CAM NOTCH VISIBLE IN RIG PIN PORT OR VERNIER REFERENCE MARKS ALIGNED AT OFF. IF CAM NOTCH OR VERNIER REFERENCE MARKS DO NOT ALIGN:

NOTE

MINIMUM STOP PLATE WIDTH AFTER FILING IS 0.280 INCH MEASURED FROM CENTERLINE OF CENTER BOLT HOLE TO FORWARD EDGE OF PLATE.

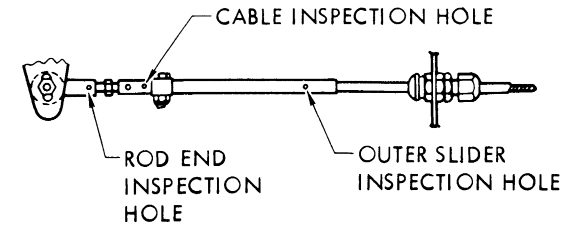
A. REMOVE QUADRANT LEVER STOP PLATE AND FILE 0.030 TO 0.090 INCH FROM FRONT EDGE. REINSTALL QUADRANT LEVER STOP PLATE AND RECHECK FOR OFF POSITION ALIGNMENT.

B. IF OFF POSITION ALIGNMENT STILL CANNOT BE OBTAINED, ADJUST BOTH RIGHT AND LEFT HAND ROD END ATTACHING BOLTS SO THAT THEY ARE AT BOTTOM OF RADIUS ADJUSTMENT SLOT AND THEN REPEAT IDLE ADJUSTMENT STARTING WITH STEP 2A.

MAJOR CHANGE

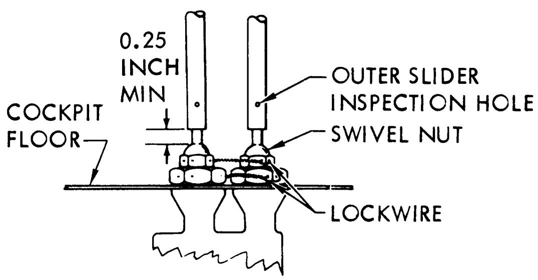
4C-2-8-(141-3)C

Figure 4-18. Airframe Power Plant Control System Wet Rigging (Preferred) (Sheet 3 of 6)



FORWARD COCKPIT
VIEW THRU DOOR 9L

2. TELESCOPIC UNIT INNER SLIDER MUST BE VISIBLE THRU OUTER SLIDE INSPECTION HOLE.

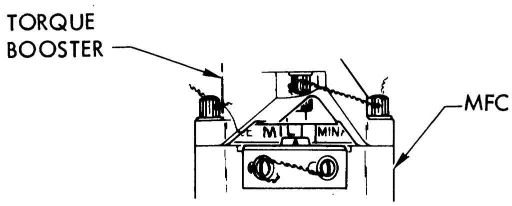


ROTATED 90°

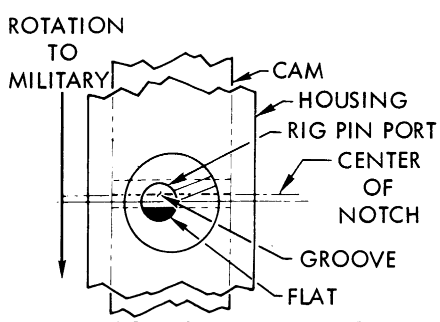
REAR COCKPIT

3. CHECK AFT COCKPIT TELESCOPIC UNIT OUTER SLIDER FOR CLEARANCE AT SWIVEL NUT.

D POSITION FORWARD COCKPIT THROTTLE LEVER TO MIL AND OBSERVE THE FOLLOWING:



VERNIER REFERENCE



CORRECTLY RIGGED TO LOW SIDE OF MIL CAM NOTCH

MFC CAM NOTCH

MAJOR CHANGE

1. CHECK MFC CAM NOTCH ALIGNMENT IN RIG PIN PORT OR ALIGNMENT OF VERNIER REFERENCE MARK. CAM NOTCH SHOULD BE ON LOW SIDE OF CAM (1/2 HOLE) OR VERNIER REFERENCE MARK - APPROXIMATELY 1/16 TO 3/32 INCH BELOW MIL.

2. IF ALIGNMENT IS OUT REFER TO STEP 3, MIL STOP PLATE ADJUSTMENT .

E RIG AFT COCKPIT THROTTLE LEVER.

F ADJUST THROTTLE CUTOFF SWITCH.

G POSITION TORQUE BOOSTER PRESSURIZATION UNIT POWER SWITCH TO OFF AND ALLOW PRESSURE TO BLEED OFF.

H DISCONNECT TORQUE BOOSTER PRESSURIZATION UNIT.

1. DISCONNECT ELECTRICAL POWER CORD AND STOW.

NOTE

DISCONNECT PRESSURE AND RETURN HOSES AT TORQUE BOOSTER FIRST TO ALLOW DRAINAGE OF FUEL BACK INTO PRESSURIZATION UNIT.

CAUTION

TO AVOID EQUIPMENT DAMAGE, PRESSURIZATION UNIT AND HOSES MUST BE DRAINED IF PROLONGED STORAGE IS TO OCCUR.

2. DISCONNECT PRESSURE AND RETURN HOSES AND STOW.
3. IF REQUIRED, DRAIN PRESSURIZATION UNIT BY OPENING DRAIN VALVE. FUEL WILL DRAIN FROM PORT ON BOTTOM OF CASE.
4. CLOSE REGULATOR AND DRAIN VALVES.
5. INSTALL DUST CAPS ON PRESSURE AND RETURN FITTINGS.
6. REMOVE GROUND WIRE FROM SAFETY GROUND POST AND INSTALL DUST CAP ON POWER INPUT RECEPTACLE.

J RECONNECT PRESSURE AND RETURN HOSE TO TORQUE BOOSTER.

K PERFORM AIRFRAME POWER PLANT CONTROL SYSTEM RIGGING CHECK - ENGINES OPERATING. REFER TO SECTION II.

4C-2-8-(141-4)C

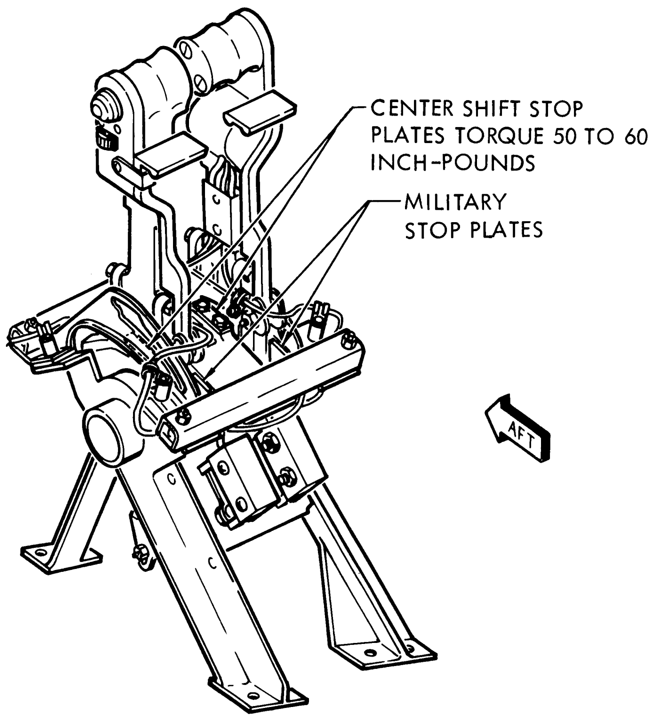
Figure 4-18. Airframe Power Plant Control System Wet Rigging (Preferred) (Sheet 4 of 6)

3 MILITARY STOP PLATE ADJUSTMENT

A REMOVE CENTER ENGINE CONTROL PANEL.

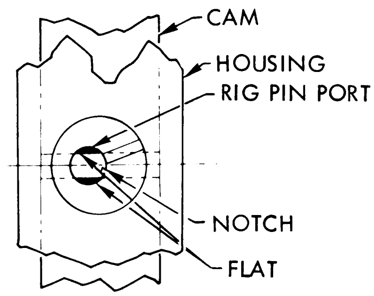
NOTE

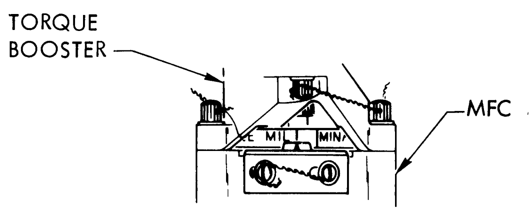
THIS METHOD OF ALIGNING CAM NOTCH OR VERNIER IS IMPORTANT FOR PROPER DISTRIBUTION OF HYSTERESIS IN SYSTEM AND WILL RESULT IN THROTTLE SYSTEM BEING RIGGED TO LOW SIDE OF MILITARY WHEN ADVANCED TO MIL.



B LOOSEN MILITARY STOP PLATE USING OFFSET SCREWDRIVER (MDT 3209) AND POSITION STOP PLATE FULL FORWARD.

C WITH TORQUE BOOSTER PRESSURIZED ADVANCE FORWARD COCKPIT THROTTLE LEVER UNTIL FIRM AGAINST STOP PLATE.





D SLOWLY RETARD FORWARD COCKPIT THROTTLE LEVER UNTIL (MFC) MIL CAM NOTCH IS ALIGNED WITH RIG PIN PORT OR VERNIER MIL REFERENCE MARKS ALIGN. IF CAM NOTCH IS INADVERTENTLY PASSED, ADVANCE THROTTLE LEVER UNTIL FIRM AGAINST MILITARY STOP AND ATTEMPT TO ALIGN CAM NOTCH OR VERNIER REFERENCE MARKS AGAIN.

NOTE

IF MILITARY STOP CANNOT BE POSITIONED AGAINST LEVER BECAUSE SERRATIONS DO NOT ALIGN, REMOVE MILITARY STOP AND FILE UNTIL STOP TOUCHES LEVER WHEN INSTALLED. DO NOT ATTEMPT TO ADJUST OUTER SLIDER TO MAKE LEVER CONTACT STOP.

E POSITION MILITARY STOP PLATE FIRM AGAINST THROTTLE LEVER AND TIGHTEN RETAINING SCREW.

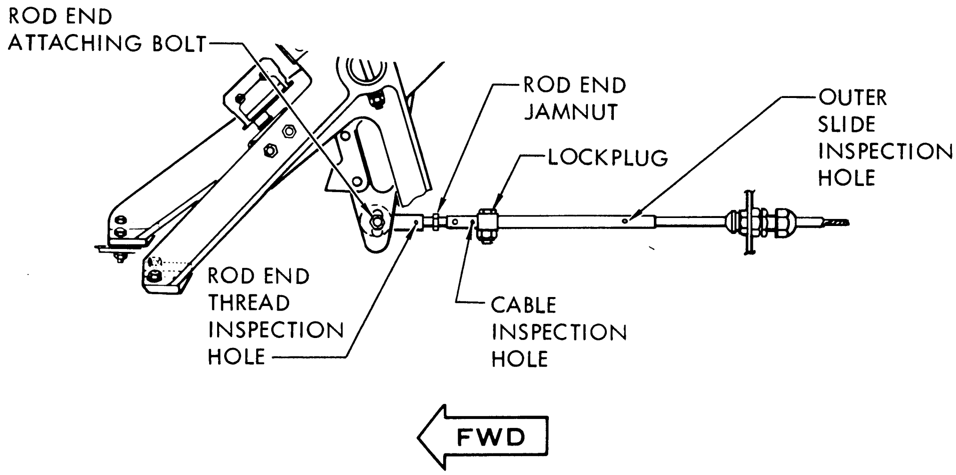
F ADJUST CENTER SHIFT STOP PLATE AND TIGHTEN. THROTTLE LEVER SHOULD SHIFT INBOARD PRIOR TO RETARDING TO IDLE. MILITARY STOP PLATE WILL STOP THROTTLE PRIOR TO SHIFTING OUTBOARD AT MIL.

MAJOR CHANGE

4C-2-8-(141-5)C

Figure 4-18. Airframe Power Plant Control System Wet Rigging (Preferred) (Sheet 5 of 6)

4 TELESCOPIC UNIT ROD END ADJUSTMENT



A LOOSEN ROD END JAMNUT AND TELESCOPIC UNIT OUTER SLIDE LOCK PLUG.

NOTE

ONE HALF TURN OF TELESCOPIC UNIT OUTER SLIDE EQUALS APPROXIMATELY 2° ROTATION OF TORQUE SHAFT AND MAIN FUEL CONTROL (MFC).

B ROTATE TELESCOPIC UNIT OUTER SLIDE AS NECESSARY TO OBTAIN ALIGNMENT. SCREW OUTERSLIDE INTO ROD END TO RETARD MFC OR OUT OF ROD END TO ADVANCE MFC.

C ASSURE CABLE IS VISIBLE IN CABLE INSPECTION HOLE AND THREADS IN ROD END INSPECTION HOLE. IF CABLE AND THREADS ARE NOT VISIBLE, REPEAT PRERIGGING PROCEDURE.

D TIGHTEN ROD END JAMNUT AND TELESCOPIC UNIT OUTER SLIDE LOCKPLUG.

E REMOVE FORWARD BOLT FROM CLEVIS LINK.

F CYCLE FORWARD COCKPIT THROTTLE LEVER BETWEEN IDLE AND MIL OF AT LEAST 10 TIMES TO REMOVE CABLE TWIST.

G CONNECT CLEVIS LINK AND INSTALL FORWARD BOLT.

H DETERMINE IF DESIRED ALIGNMENT HAS BEEN ACHIEVED. IF NOT, REPEAT STEPS A THRU G.

J TORQUE CLEVIS LINK BOLT 13 TO 15 INCH-POUNDS AND INSTALL COTTER PIN.

MAJOR CHANGE

4C-2-8-(141-6)C

Figure 4-18. Airframe Power Plant Control System Wet Rigging (Preferred) (Sheet 6 of 6)

"All data on pages 4-102 thru 4-103 including figure 4-18 sheets 7 thru 8 deleted."

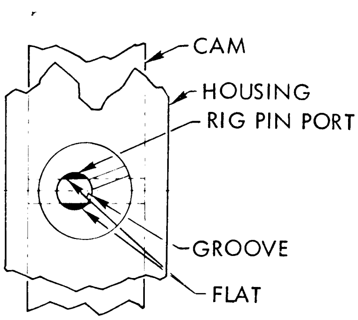
NOTE

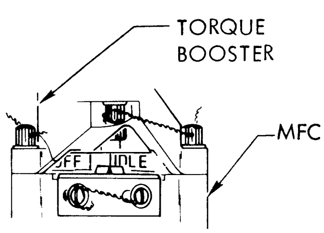
FOLLOWING DRY RIGGING PROCEDURE IS AN ALTERNATE PROCEDURE AND SHOULD BE USED ONLY WHEN IC3568G1 PRESSURIZING UNIT CANNOT BE OBTAINED.

A ASSURE AIRFRAME POWER PLANT PRERIGGING PROCEDURE IS PERFORMED.

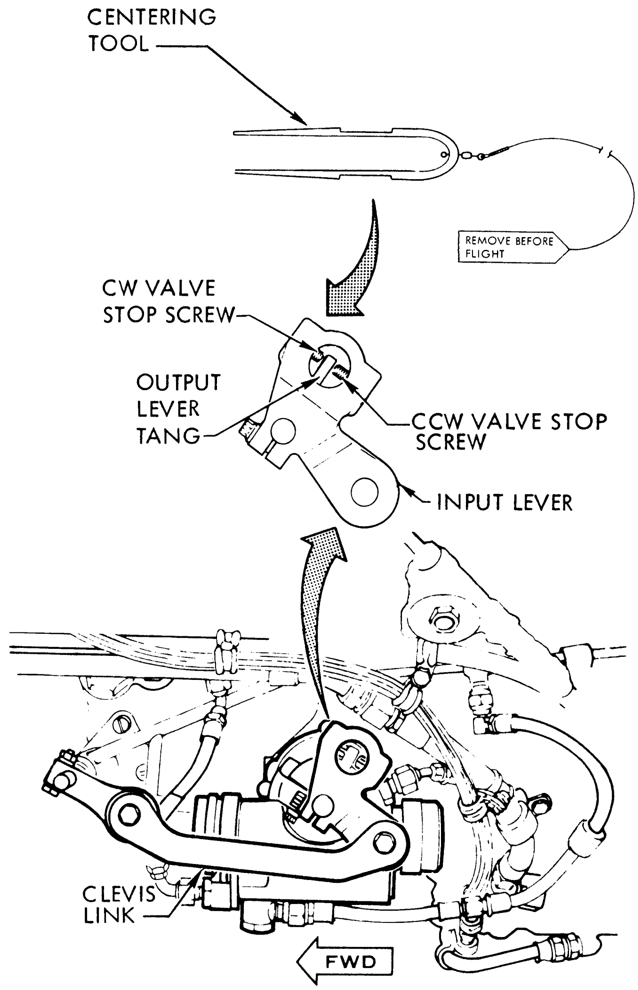
B DISCONNECT ENGINE CONTROL BOX FROM MFC CROSSOVER SHAFT.

C PLACE FORWARD COCKPIT THROTTLE AT IDLE STOP AND APPLY FRICTION LOCK.





D ROTATE TORQUE BOOSTER INPUT LEVER TO POSITION MAIN FUEL CONTROL AT IDLE. INSERT RIG PIN IN MFC RIG PIN PORT.



CAUTION

DO NOT DISTURB VALVE STOP SCREW ADJUSTMENT, OPERATION OF TORQUE BOOSTER WILL BE IMPAIRED.

E CENTER TORQUE BOOSTER INPUT LEVER, INSTALL CENTERING TOOL AND ATTEMPT ENGAGEMENT OF CONTROL BOX TORQUE SHAFT TO MFC CROSSOVER SHAFT.

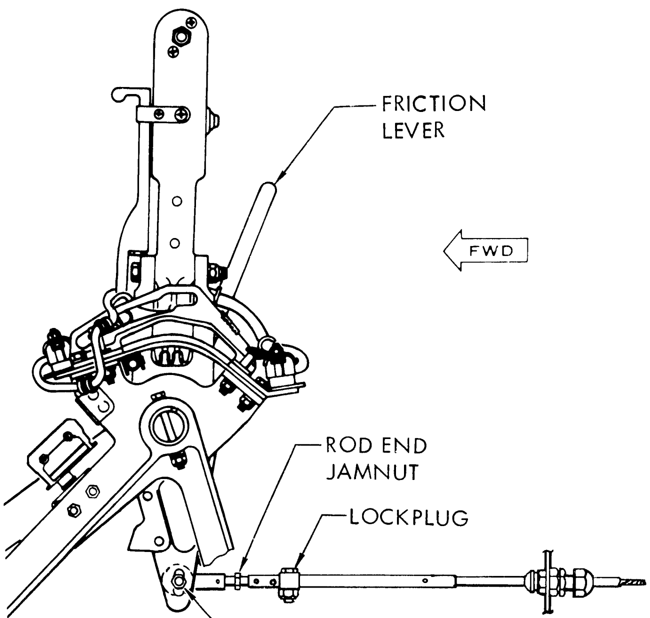
F IF SPLINE ALIGNMENT IS NOT OBTAINED, LOOSEN ROD END JAMNUT AND TELESCOPIC UNIT OUTER SLIDE LOCK PLUG.

MAJOR CHANGE

4C-2-8-(143-1)C

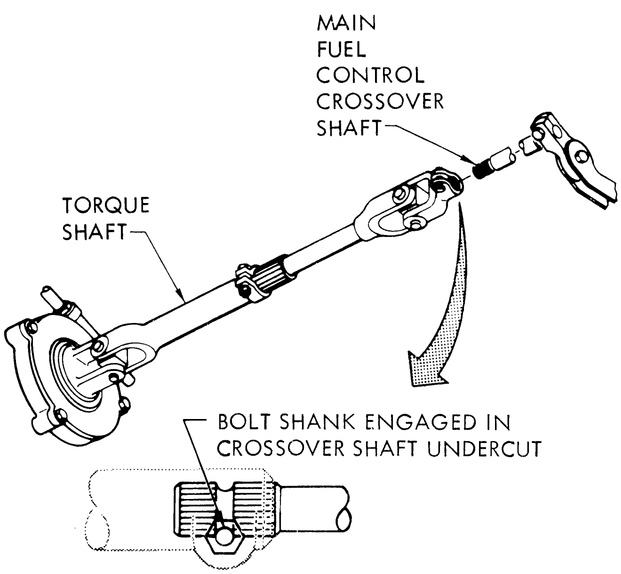
Figure 4-19. Airframe Power Plant Control System Dry Rigging (Sheet 1 of 5)

G ROTATE TELESCOPIC UNIT OUTER SLIDE IN DIRECTION REQUIRING LEAST AMOUNT OF ROTATION UNTIL SPLINE ALIGNMENT IS ATTAINED.



WARNING

TO PREVENT LOSS OF THROTTLE CONTROL, DO NOT INSTALL 3/16 INCH BOLTS IN TORQUE SHAFTS HAVING 1/4 INCH HOLES.

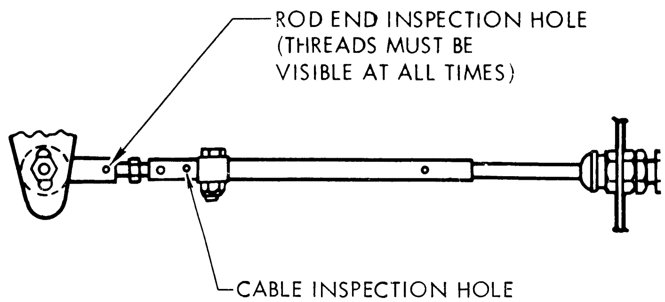


PROPER BOLT INSTALLATION

CAUTION

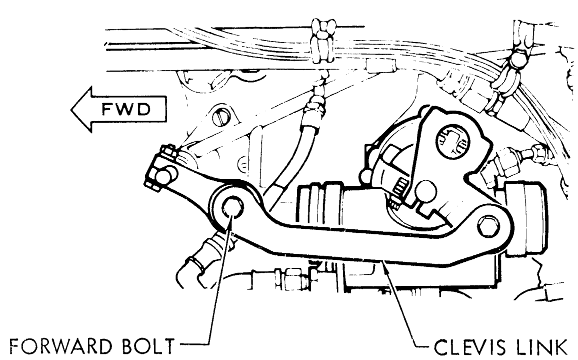
ASSURE BOLT ENGAGES UNDERCUT OF CROSSOVER SHAFT AFTER INSTALLATION TO PREVENT THROTTLE FROM BECOMING DISCONNECTED.

H CONNECT TWO SHAFTS TOGETHER AND INSTALL BOLT. TORQUE 3/16 INCH DIAMETER BOLTS 13 TO 15 INCH-POUNDS AND 1/4 INCH DIAMETER BOLTS 30 TO 40 INCH-POUNDS. USE WASHERS AS REQUIRED TO ASSURE NUT DOES NOT BOTTOM OUT. INSTALL COTTER PIN.



J TIGHTEN ROD END JAMNUT AND TELESCOPIC UNIT OUTER SLIDE LOCKPLUG.

K ASSURE THREADS ARE VISIBLE IN ROD END INSPECTION HOLE AND CABLE IS VISIBLE IN CABLE INSPECTION HOLE.



L REMOVE FORWARD BOLT FROM CLEVIS LINK.

4C-2-8-(143-2)D

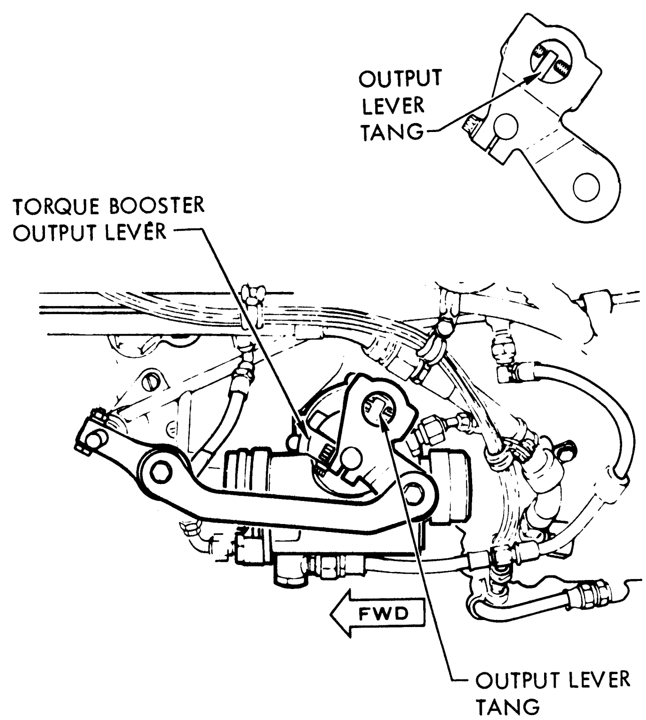
Figure 4-19. Airframe Power Plant Control System Dry Rigging (Sheet 2 of 5)

M RELEASE FRICTION LOCK AND CYCLE FORWARD COCKPIT LEVER BETWEEN IDLE AND MIL AT LEAST 10 TIMES TO REMOVE ANY POSSIBLE CABLE TWIST.

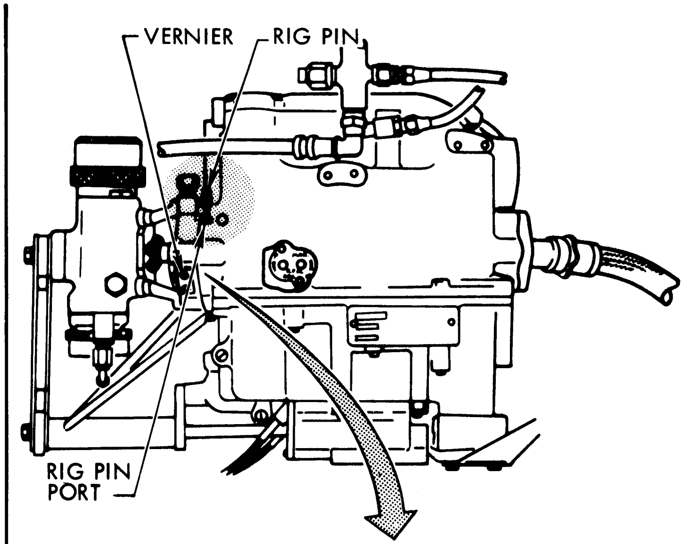
N ASSEMBLE AND REINSTALL FORWARD BOLT IN CLEVIS LINK. TORQUE NUT 13 TO 15 INCH-POUNDS AND INSTALL COTTER PIN.

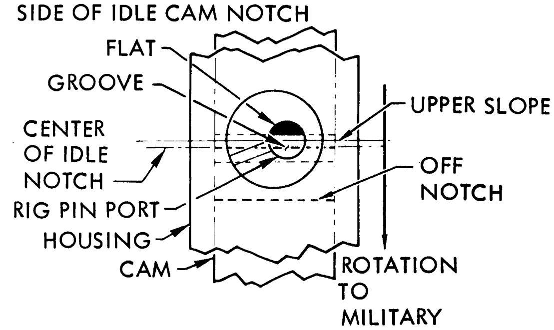
O REMOVE RIG PIN FROM MFC RIG PIN PORT AND CENTERING TOOL FROM TORQUE BOOSTER INPUT ARM.

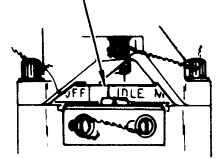
P ADVANCE THROTTLE TOWARD MIL AND RETARD TO IDLE.



Q POSITION OUTPUT LEVER OF TORQUE BOOSTER TO CENTER THE OUTPUT LEVER TANG AND REINSTALL CENTERING TOOL.







R ASSURE CAM NOTCH IS POSITIONED ON HIGH SIDE OF CAM OR VERNIER REFERENCE MARK IS 1/32 INCH TO 1/16 INCH ABOVE IDLE. REMOVE CENTERING TOOL.

4C–2–8–(143–3)C

Figure 4-19. Airframe Power Plant Control System Dry Rigging (Sheet 3 of 5)

S POSITION FORWARD COCKPIT THROTTLE LEVER TO OFF. OBSERVE THE FOLLOWING:

1. MFC OFF CAM NOTCH VISIBLE IN RIG PIN PORT OR VERNIER REFERENCE MARKS ALIGNED AT OFF. IF CAM NOTCH OR VERNIER REFERENCE MARKS DO NOT ALIGN:

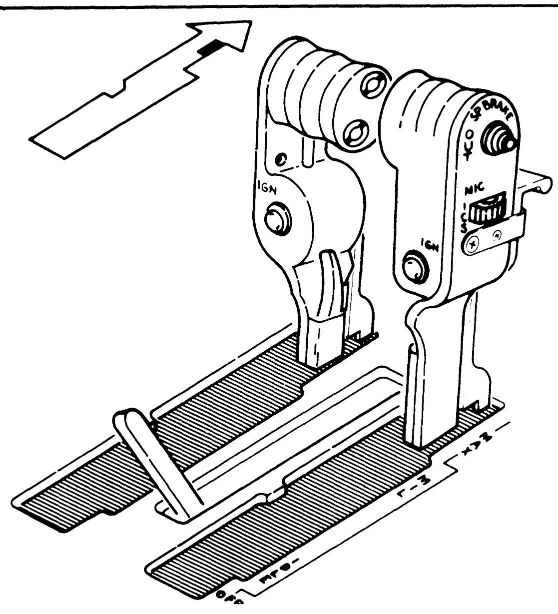
NOTE

MINIMUM STOP PLATE WIDTH AFTER FILING IS 0.280 INCH MEASURED FROM CENTERLINE OF CENTER BOLT HOLE TO FORWARD EDGE OF PLATE.

a. REMOVE QUADRANT LEVER STOP PLATE AND FILE 0.030 TO 0.090 INCH FROM FRONT EDGE. REINSTALL QUADRANT LEVER STOP PLATE AND RECHECK OFF POSITION ALIGNMENT.

b. IF OFF POSITION ALIGNMENT STILL CANNOT BE OBTAINED, ADJUST BOTH LEFT AND RIGHT ROD END ATTACHING BOLTS SO THAT THEY ARE AT BOTTOM OF RADIUS ADJUSTMENT SLOT.

2. TELESCOPIC UNIT INNER SLIDER MUST BE VISIBLE THRU OUTER SLIDER INSPECTION HOLE.

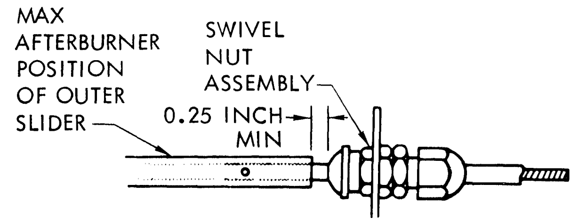


NOTE

WHEN COCKPIT THROTTLE LEVER WILL NOT SHIFT INBOARD OR OUTBOARD, REPOSITION CENTER SHIFT STOP PLATE.

MAJOR CHANGE

T POSITION FORWARD COCKPIT THROTTLE LEVER TO MAX AB.



1. CHECK TELESCOPIC UNIT OUTER SLIDE FOR CLEARANCE AT SWIVEL NUT.

2. BOTH COCKPIT THROTTLE LEVERS MUST NOT CONTACT QUADRANT STRUCTURE BEFORE MAXIMUM TRAVEL STOP IN MFC IS CONTACTED.

U IF CONDITIONS OF STEPS S AND T ARE NOT MET, THIS INDICATES THAT PRERIGGING CHECKS WERE NOT PERFORMED AS PRESCRIBED. REVIEW PRERIG PROCEDURES.

V CHECK MILITARY STOP PLATE ADJUSTMENT DURING POWER PLANT CONTROL SYSTEM RIGGING CHECK-ENGINES OPERATING. IF ALIGNMENT IS OUT, REFER TO STEP AC (MILITARY STOP PLATE ADJUSTMENT).

W CYCLE THROTTLE AND RECHECK IDLE POSITION PER STEPS Q AND R.

X THROTTLE LEVERS SHOULD BE ALIGNED WITHIN 1/4 INCH IF PRESCRIBED WEAR CHECKS AND PRERIG PROCEDURES HAVE BEEN ADHERED TO.

Y CHECK ALL AREAS OF THROTTLE QUADRANT, TELEFLEX, CONTROL BOX, AND CLEVIS ARM. TORQUING AND SAFETYING ALL ITEMS OF ASSEMBLY AND ADJUSTMENT.

Z RIG AFT COCKPIT THROTTLE LEVER.

AA ADJUST THROTTLE CUTOFF SWITCH.

NOTE

THIS IS AN ALTERNATE METHOD OF THROTTLE RIGGING AND MAY REQUIRE FINE ADJUSTMENT DURING PERFORMANCE OF RIGGING CHECK-ENGINES OPERATING. IF ANY ADJUSTMENT IS NEEDED, ADJUST IDLE FIRST USING TELESCOPIC SLIDER PROCEDURE FOLLOWED BY ADJUSTMENT OF MILITARY STOP PLATE.

AB PERFORM AIRFRAME POWER PLANT SYSTEM RIGGING CHECK - ENGINES OPERATING, REFER TO SECTION II.

4C-2-8-(143-4)C

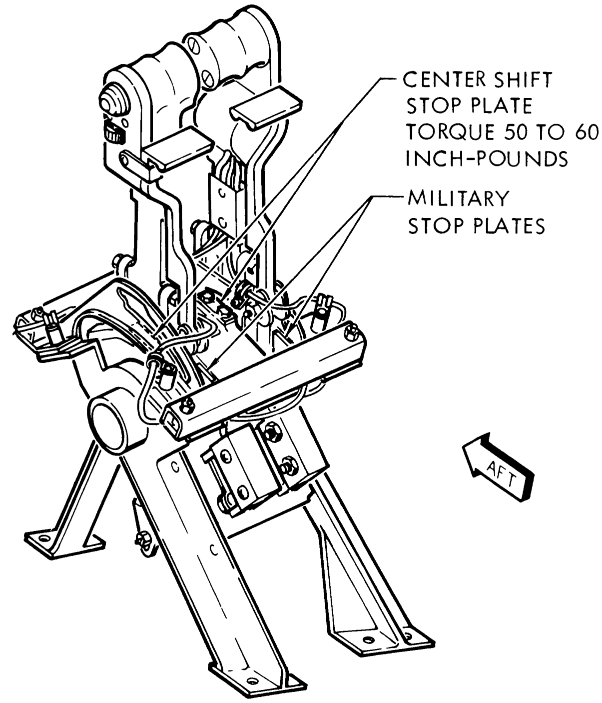
Figure 4-19. Airframe Power Plant Control System Dry Rigging (Sheet 4 of 5)

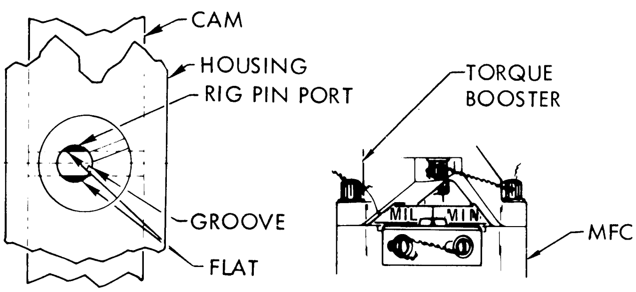
AC MILITARY STOP PLATE ADJUSTMENT.

1. REMOVE CENTER ENGINE CONTROL PANEL.

2. LOOSEN MILITARY STOP PLATE USING OFFSET SCREWDRIVER (MDT 3209) AND POSITION STOP PLATE FULL FORWARD.

3. ADVANCE FORWARD COCKPIT THROTTLE LEVER UNTIL FIRM AGAINST MILITARY STOP PLATE.





4. SLOWLY RETARD FORWARD COCKPIT THROTTLE LEVER UNTIL (MFC) MIL CAM NOTCH IS ALIGNED WITH RIG PIN PORT OR VERNIER MIL REFERENCE MARKS ALIGN. IF CAM NOTCH IS INADVERTENTLY PASSED, ADVANCE THROTTLE LEVER UNTIL FIRM AGAINST MILITARY STOP AND ATTEMPT TO ALIGN CAM NOTCH OR VERNIER REFERENCE MARKS AGAIN.

NOTE

THIS METHOD OF ALIGNING CAM NOTCH OR VERNIER IS IMPORTANT FOR PROPER DISTRIBUTION OF HYSTERESIS IN SYSTEM AND WILL RESULT IN THROTTLE SYSTEM BEING RIGGED TO LOW SIDE OF MILITARY WHEN ADVANCING TO MIL.

NOTE

IF MILITARY STOP CANNOT BE POSITIONED AGAINST LEVER BECAUSE SERRATIONS DO NOT ALIGN, REMOVE MILITARY STOP AND FILE UNTIL STOP TOUCHES LEVER WHEN INSTALLED. DO NOT ATTEMPT TO ADJUST OUTER SLIDER TO MAKE LEVER CONTACT STOP.

5. POSITION MILITARY STOP PLATE FIRM AGAINST THROTTLE LEVER AND TIGHTEN RETAINING SCREW.

6. ADJUST CENTER SHIFT STOP PLATE AND TIGHTEN. THROTTLE LEVER SHOULD SHIFT INBOARD PRIOR TO RETARDING TO IDLE. MILITARY STOP PLATE WILL STOP THROTTLE PRIOR TO SHIFTING OUTBOARD AT MIL.

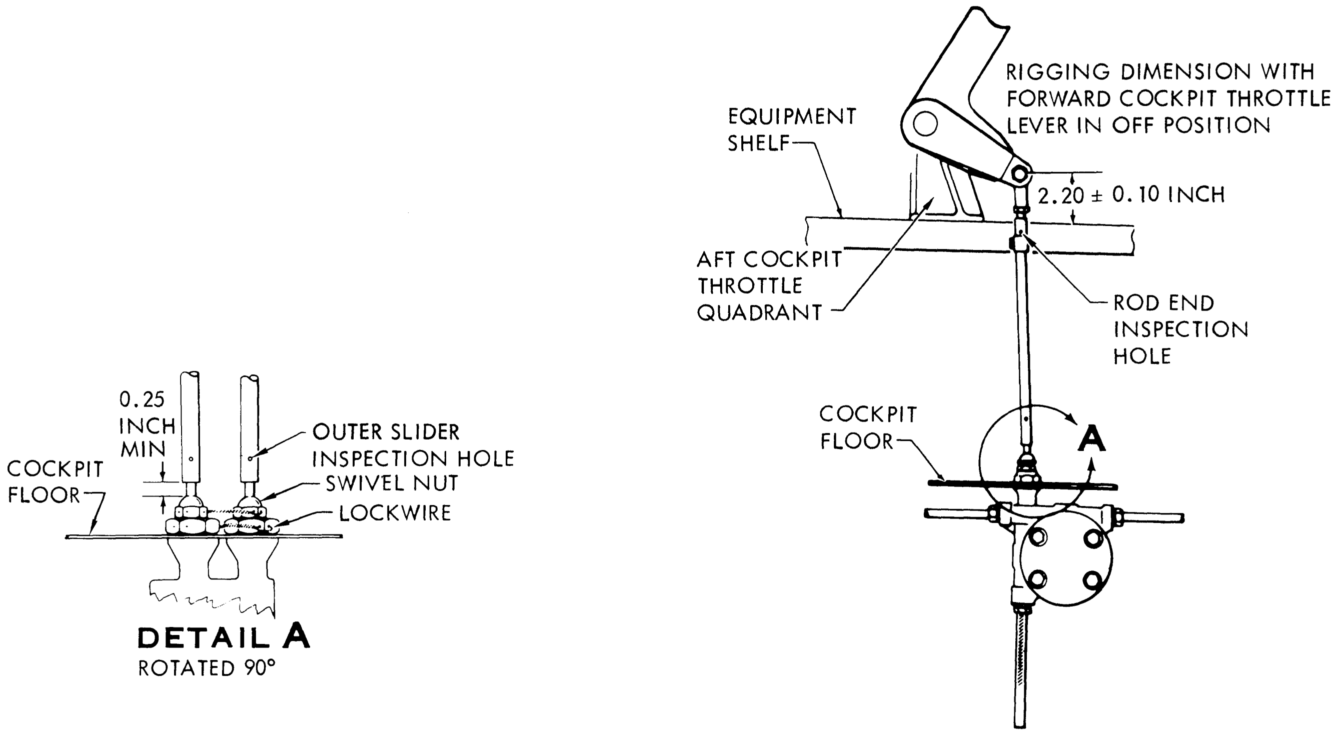
MAJOR CHANGE

4C-2-8-(143-5)C

Figure 4-19. Airframe Power Plant Control System Dry Rigging (Sheet 5 of 5)

 "All data on pages 4-109 thru 4-113 including figure 4-19 sheets 6 thru 12 deleted."

A CHECK AFT COCKPIT THROTTLE LEVERS FOR PROPER RIG. WHEN ANY OF FOLLOWING REQUIREMENTS ARE NOT SATISFACTORY, ADJUST TELEFLEX CABLES. REFER TO TELEFLEX CABLE REMOVAL AND INSTALLATION FOR PROCEDURES.



B POSITION FORWARD COCKPIT THROTTLE LEVERS AT OFF.

1. AFT COCKPIT THROTTLE LEVERS MUST HAVE CUSHION (DOES NOT CONTACT QUADRANT, CAM OR CONSOLE PANELS).

2. AFT COCKPIT TELESCOPIC UNIT OUTER SLIDER TO SWIVEL NUT FOR 0.25 INCH MINIMUM CLEARANCE. USE OF AUTHORIZED SPECIAL TOOL IS OPTIONAL. (SEE ILLUSTRATION TITLED THROTTLE RIG TOOL).

C POSITION FORWARD COCKPIT THROTTLE LEVERS AT MAX AB.

1. AFT COCKPIT THROTTLE LEVERS MUST HAVE CUSHION (DOES NOT CONTACT QUADRANT OR CONSOLE PANELS).

2. AFT COCKPIT TELESCOPIC UNIT INNER SLIDER MUST BE VISIBLE THRU INSPECTION HOLE OF OUTER SLIDER.

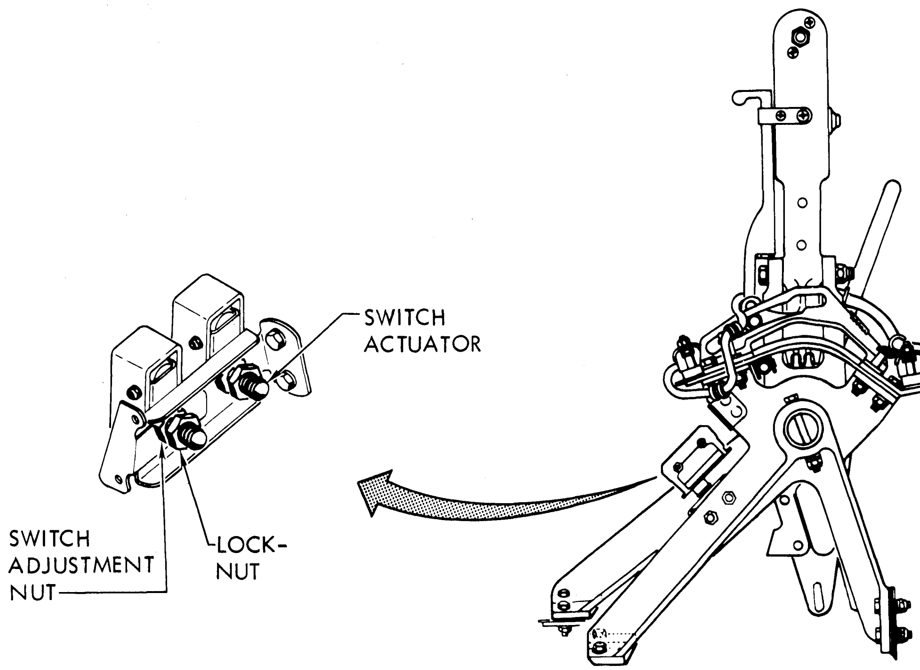
D POSITION FORWARD COCKPIT THROTTLE LEVERS AT OFF.

1. CHECK DIMENSION BETWEEN TOP OF EQUIPMENT SHELF TO CENTER-LINE OF ROD END ATTACH BOLT.

2. ASSURE BOTH AFT COCKPIT THROTTLE LEVERS ARE ALIGNED WITHIN 1/4 INCH.

4C–2–8–(193)

Figure 4-19A. Aft Cockpit Throttle Rigging



CAUTION

ASSURE SWITCH ACTUATOR OPERATES FREELY OR ENGINE MANIFOLD SHUTOFF VALVE WILL NOT OPERATE PROPERLY.

NOTE

THROTTLE CUTOFF SWITCH ADJUSTMENT MUST BE CHECKED EACH TIME THROTTLE SYSTEM RIGGING IS ACCOMPLISHED.

A PLACE THROTTLE LEVER IN OFF POSITION.

B LOOSEN LOCKNUT AND TURN ADJUSTMENT NUT TO OBTAIN SWITCH ACTUATOR OVERTRAVEL OF 0.08 ±0.03 INCH (APPROXIMATELY 2.5 THREADS) BEYOND WHERE NORMALLY OPEN CONTACTS CLOSE (AUDIBLE SWITCH ACTUATION POINT).

C TIGHTEN ADJUSTMENT NUT AND LOCKNUT.

4C-2-8-(194)

Figure 4-19B. Throttle Cutoff Switch Adjustment

4-130. **FRICTION LOCK RATCHET ADJUSTMENT.**

a. Remove center engine control panel from between throttle levers.

b. Remove lighting panel from center engine control panel by removing two screws.

c. Loosen two screws that attach ratchet to panel.

d. Extend ratchet to increase locking action or retract ratchet to decrease locking action. Tighten two screws.

e. Reinstall center engine control panel and check operation of friction lever. Ratchet should provide a positive lock but should not restrict movement of friction lever.

f. Remove center engine control panel and reinstall lighting panel.

g. Reinstall center engine control panel.

4-131. ***Quality Assurance Summary.***

a. *Assure proper operation of friction lever.*

4-132. **ENGINE CONTROL SYSTEM ADJUSTMENT PROCEDURES.** The following adjustments are authorized for operational (line) personnel. No other adjustments should be attempted. See figure 4-20.

4-133. **Idle Speed.** Do not attempt to adjust idle or military rpm with main fuel control adjustment screws, without first performing an airframe power plant control system rigging check to assure airframe throttle system is properly rigged. For adjustment procedures utilizing the BH112J or JA Jetcal analyzer, see figure 4-21 or for BH112JB-40 Jetcal analyzer/trimmer procedures, refer to paragraph 4-137A.

4-134. **Top Speed.** Except to correct flight squawks, no adjustment is required if engine speed falls within the tolerance bands of section II. Do not adjust for purposes of setting speed on the nominal line. When military engine speeds falls on the slope of the speed schedule, set speed toward the minimum limit to avoid possible overspeed when CIT increases. A minor readjustment may be necessary after the first flight or after ambient temperature rises above 4.4°C. When engine operation is switched from JP-4 to JP-5, slight rise in steady state speed can be expected and a minor adjustment downward may be required. The reverse is true when switching from JP-5 to JP-4. For adjustment procedures utilizing the BH112J or JA Jetcal analyzer, see figure 4-21 or for BH112JB-40 Jetcal analyzer/trimmer procedures, refer to paragraph 4-137A.

4-135. **Exhaust Gas Temperature.** When EGT adjustment is necessary, use jetcal. Use procedure shown in figure 4-22 for BH112J or JA Jetcal analyzer or refer to paragraph 4-137B for BH112JB-40 Jetcal analyzer/trimmer. Always adjust reference temperature as close as possible to nominal line. During subsequent ground and flight operations, exhaust gas temperature may vary 10°C from set value. This is normal limit of nozzle control system if engine speed remains constant. EGT will remain at 625°C above 98 percent RPM. During speed decreases below 98 percent, EGT will decrease according to schedule. Turn adjustment on temperature amplifier colckwise to increase, counterclockwise to decrease temperature. One full turn changes reference to temperature about 4°C (8 °F).

4-136. **Specific Gravity.** There are two fuel specific gravity adjustments, one for the main fuel system and the other for the afterburner fuel system. These adjustments are to be made only when a change of fuels is authorized. The main fuel control specific gravity adjustment is next to the fuel outlet port on the control. It adjusts the control to use fuel with specific gravities ranging from 0.72 to 0.85. Use the following procedure to prevent unnecessary damage to the control during adjustment.

CAUTION

Do not remove cover plate.

a. Cut lockwire and loosen screw holding cover over adjustment socket.

b. Rotate cover to allow access to adjustment socket.

c. Tighten cover screw; otherwise, cam may be unseated if wrench sticks when pulled out.

d. Make adjustment by pointing adjustment notch to desired value.

e. Loosen cover screw and rotate cover over adjustment socket.

f. *Tighten screw and lockwire.*

4-137. The afterburner fuel control specific gravity adjustment is next to the fuel outlet port on the control. It adjusts the control to use fuels with specific gravities ranging from 0.69 to 0.90. Point the adjustment arrow to the desired setting.

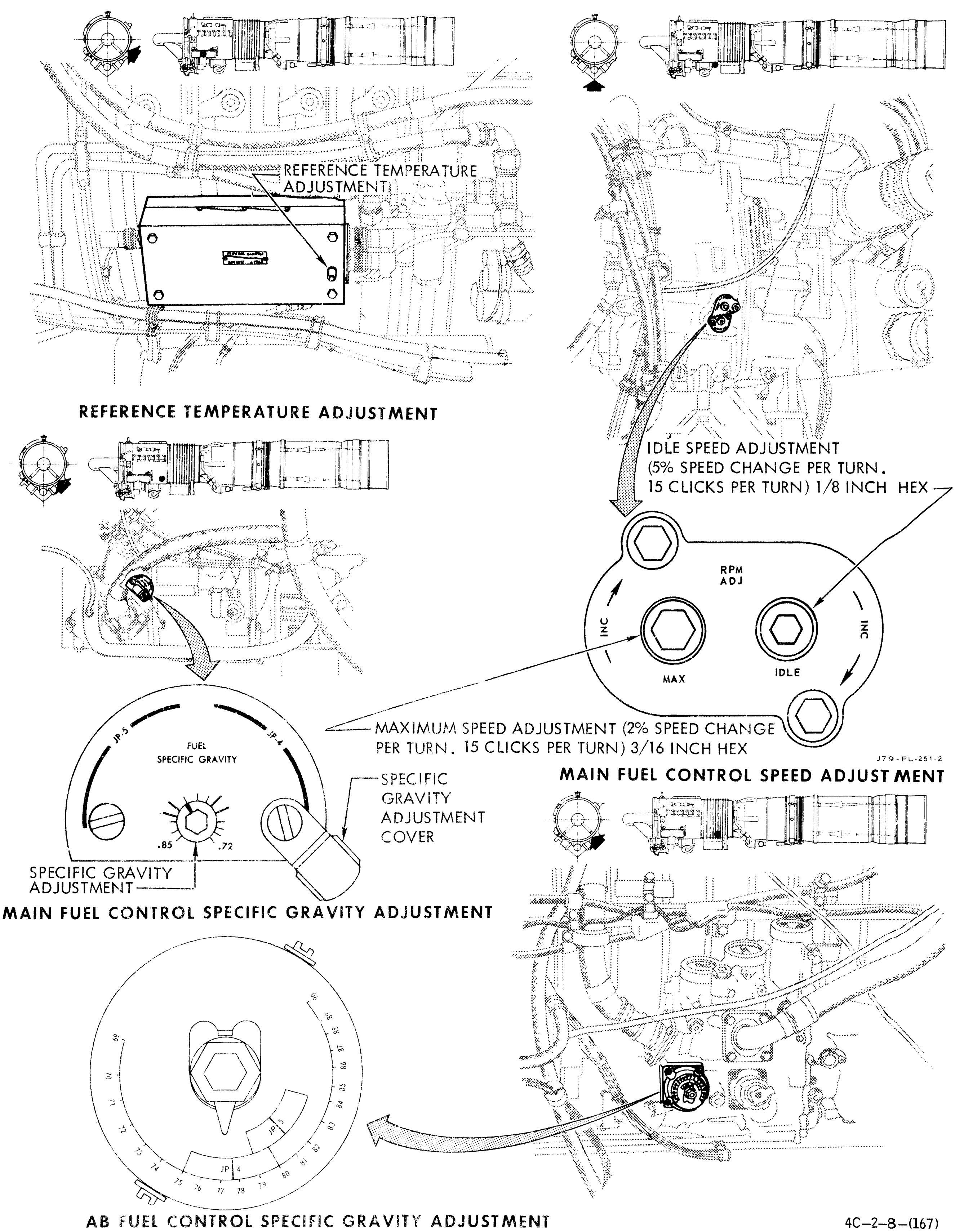


Figure 4-20. Control Adjustment Points

NOTE

PREPARE JETCAL ANALYZER BY PERFORMING JETCAL INITIAL OPERATING PROCEDURES.

TOOLS AND TEST EQUIPMENT

JETCAL ANALYZER .... BH112J OR BH112J/A
RPM CHECK ADAPTER BH907-85
INSTRUMENT CABLE ASSY BH485

MATERIALS

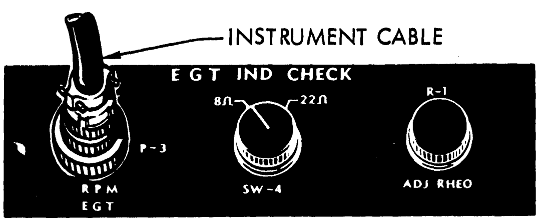
LOCKWIRE MS20995NC20

MANPOWER REQUIREMENT

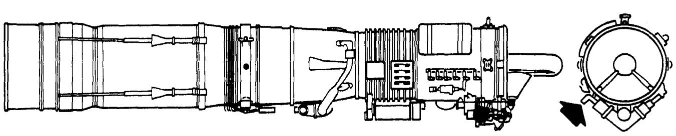
TWO MEN REQUIRED

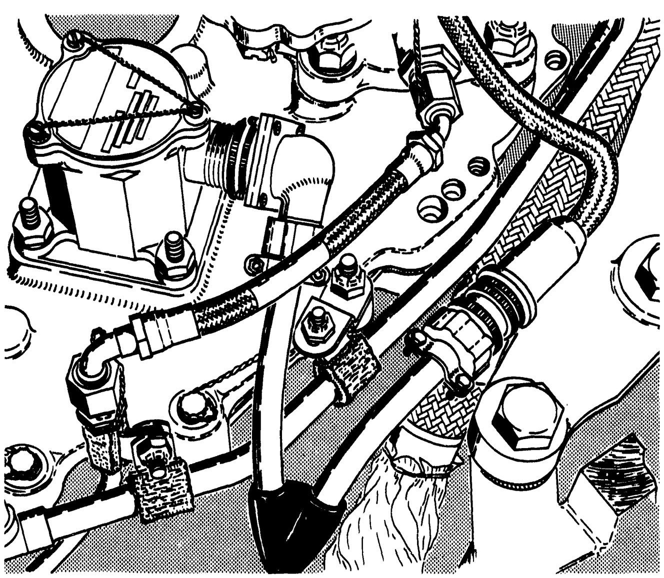
CAUTION

ASSURE AIRFRAME THROTTLE SYSTEM HAS BEEN PROPERLY RIGGED BEFORE ATTEMPTING FOLLOWING PROCEDURE.

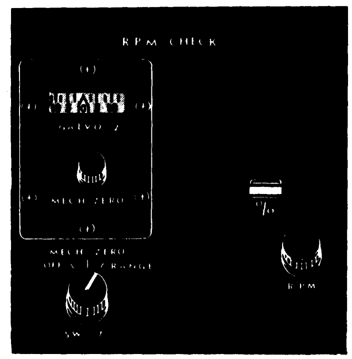


A CONNECT INSTRUMENT CABLE TO RECEPTACLE P-3.





B REMOVE LOCKWIRE AND DISCONNECT THE INDICATOR LEAD FROM THE TACHOMETER GENERATOR AND CONNECT THE PRM CHECK ADAPTER TO TACHOMETER GENERATOR AND TO INDICATOR LEAD AS SHOWN. CONNECT THIRD END OF ADAPTER TO INSTRUMENT CABLE.



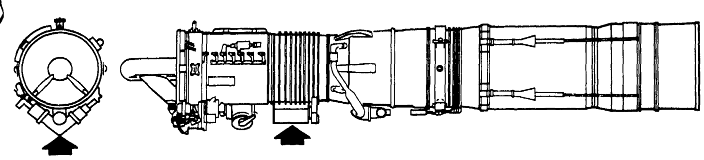
C PLACE SW-7 IN MECH ZERO AND ADJUST MECH.ZERO KNOB UNTIL GALVO-2 READS ZERO.

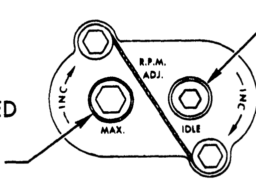
D PLACE SW-7 IN RANGE.

E START ENGINE AND PLACE THROTTLE IN IDLE.

F RPM READINGS ARE MADE BY ADJUSTING RPM KNOB UNTIL GALVO-2 READS ZERO. PRM READING APPEARS ON % SCALE.

SPEED ADJUSTMENT TABLE		
IDLE SPEED	THROTTLE POSITION	10° - 13°
	ENGINE RPM	65%
MILITARY	THROTTLE POSITION	72° THRU 75°
	ENGINE RPM	100%





CAUTION

SPEED ADJUSTMENTS MUST BE MADE ONLY IN RANGE OF THROTTLE POSITION SHOWN IN SPEED ADJUSTMENT TABLE.

4C-2-8-(179-1)B

Figure 4-21. BH112J or JA Jetcal Analyzer - Engine Speed Adjustment (Sheet 1 of 2)

G IF IDLE SPEED IS NOT WITHIN LIMITS, ADJUST AS FOLLOWS: TURN IDLE SPEED ADJUSTMENT ON MAIN FUEL CONTROL CLOCKWISE (CW) TO INCREASE SPEED, COUNTERCLOCKWISE (CCW) TO DECREASE SPEED. ONE CLICK WILL CHANGE SPEED APPROXIMATELY 25 RPM (ONE FULL TURN EQUALS APPROXIMATELY 5 PERCENT ENGINE RPM).

H ADVANCE THROTTLE SLOWLY TO MIL.

CAUTION

AVOID OVERSPEED AND OVERTEMPERATURE.

NOTE

WHEN OUTSIDE TEMPERATURE FALLS BELOW 4.4°C (40°F) ENGINE TOP SPEED WILL NOT REACH 100% RPM. WHEN MILITARY ENGINE SPEED FALLS ON SLOPE OF SPEED SCHEDULE, SET SPEED TOWARD MINIMUM LIMIT TO AVOID POSSIBLE OVERSPEED WHEN CIT INCREASES.

I IF TOP SPEED IS NOT WITHIN LIMITS, DECELERATE TO IDLE AND ADJUST AS FOLLOWS: TURN MAXIMUM SPEED ADJUSTMENT ON MAIN FUEL CONTROL CLOCKWISE (CW) TO INCREASE SPEED, COUNTERCLOCKWISE (CCW) TO DECREASE SPEED. ONE CLICK CHANGES TOP SPEED APPROXIMATELY 9 RPM (ONE FULL TURN CHANGES TOP SPEED APPROXIMATELY 2 PERCENT ENGINE RPM).

J SHUT DOWN ENGINE AND PLACE SW-7 OFF.

CAUTION

PLACE SW-7 OFF BEFORE REMOVING CABLES FROM ENGINE AND ANALYZER.

K REMOVE RPM CHECK ADAPTER FROM ENGINE.

L CONNECT INDICATOR LEAD TO TACHOMETER GENERATOR AND LOCKWIRE.

4C-2-8-(179-2)

Figure 4-21. BH112J or JA Jetcal Analyzer - Engine Speed Adjustment (Sheet 2 of 2)

JETCAL CHECK PROCEDURE IV

NOTE

PREPARE JETCAL ANALYZER BY PERFORMING JETCAL INITIAL OPERATING PROCEDURES.

TOOLS AND TEST EQUIPMENT

JETCAL ANALYZER .... BH112 J OR BH112J/A
SWITCH BOX LEAD BH1032-3
SWITCH BOX LEAD BH1033-3
CHECK CABLE ASSY BH450
SWITCH BOX BH123-3

MATERIALS

LOCKWIRE, MS20995NC20

MANPOWER REQUIREMENT

TWO MEN REQUIRED.

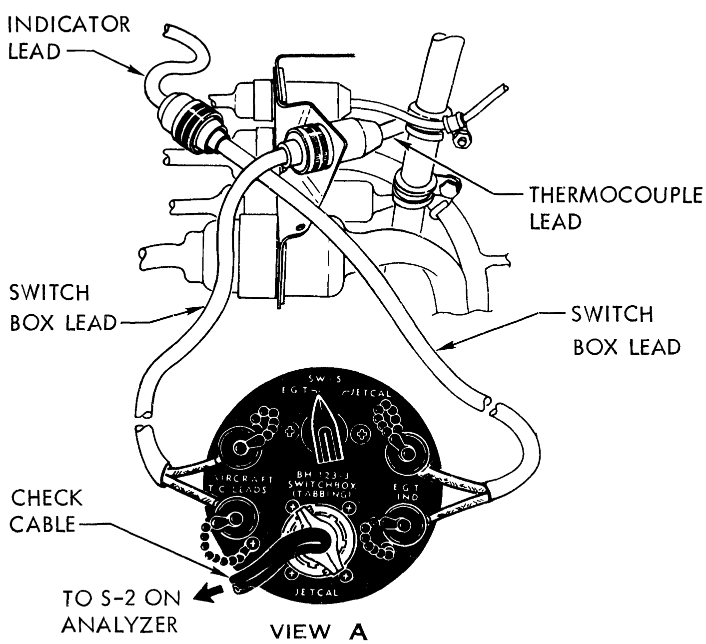
CAUTION

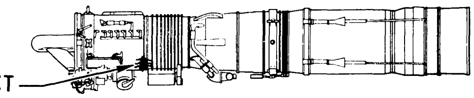
THIS PROCEDURE IS TO BE USED ONLY DURING FINAL EGT ADJUSTMENT. UNDER NO CIRCUMSTANCES IS IT INTENDED TO REPLACE EGT SYSTEM FUNCTIONAL CHECK.

NOTE

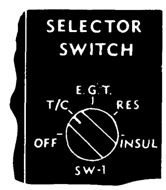
IF EGT FALLS OUTSIDE TOLERANCE BANDS OF SECTION II ON JETCAL READING, A COMPLETE EGT SYSTEM FUNCTIONAL CHECK IS REQUIRED BEFORE ANY TEMPERATURE ADJUSTMENTS ARE MADE. IF EGT FALLS WITHIN TOLERANCE BANDS TEMPERATURE ADJUSTMENT IS ALLOWED WITHOUT PERFORMING A COMPLETE SYSTEM FUNCTIONAL CHECK.

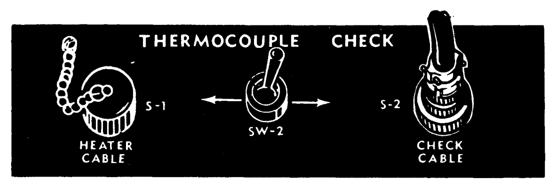
A CONNECT CHECK CABLE TO RECEPTACLE S-2 ON ANALYZER AND TO SWITCH BOX.





B REMOVE LOCKWIRE AND DISCONNECT INDICATOR LEAD AT ENGINE ELECTRICAL DISCONNECT. CONNECT SWITCH BOX LEAD BETWEEN ENGINE DISCONNECT AND SWITCH BOX POSTS LABELED AIRCRAFT T. C. LEADS. CONNECT SWITCH BOX LEAD AND EGT IND POSTS.





C PLACE SW-5 ON SWITCH BOX IN EGT.

NOTE

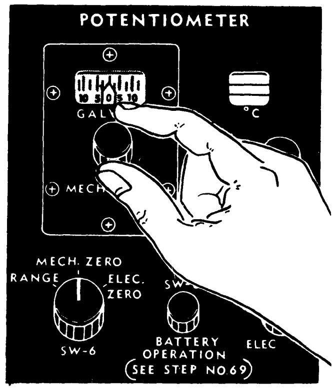
COCKPIT INDICATOR MUST ALWAYS BE USED DURING TRANSIENT CONDITIONS TO ENABLE ENGINE OPERATOR TO MONITOR EGT.

D PLACE SW-1 IN T/C AND SW-2 IN S-2.

4C-2-8-(178-1)C

Figure 4-22. BH112J or JA Jetcal Analyzer - Exhaust Gas Temperature Adjustment (Jetcal Procedure IV) (Sheet 1 of 2)

E PLACE SW-6 IN MECH.ZERO AND ADJUST MECH. ZERO KNOB UNTIL GALVO-1 READS ZERO.



F HOLD SW-6 IN ELEC.ZERO AND ADJUST ELEC.ZERO (R-3) KNOB UNTIL GALVO-1 READS ZERO.

G PLACE SW-6 IN RANGE.

H SET TEMPERATURE SELECTOR KNOB TO PROVIDE READOUT OF 625°C ON °C SCALE.

NOTE

BELOW CIT OF 4.4°C(40°F), SEE FIGURE TITLED EGT AND RPM SCHEDULE. SET TEMPERATURE SELECTOR KNOB TO NOMINAL VALUE GIVEN ON SCHEDULE.

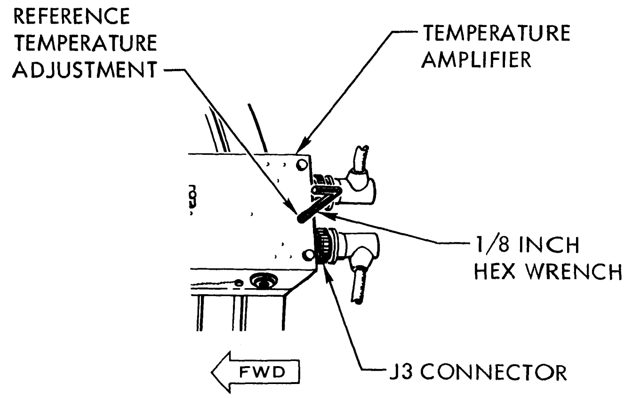
I START ENGINE AND STABILIZE AT MIL.

CAUTION

DO NOT LET EGT EXCEED TEMPERATURE LIMITS.

J PLACE SW-5 IN JETCAL.

K TURN REFERENCE TEMPERATURE ADJUSTMENT ON TEMPERATURE AMPLIFIER TO ZERO GALVO-1.



NOTE

TURN REFERENCE TEMPERATURE ADJUSTMENT CLOCKWISE TO INCREASE, COUNTER-CLOCKWISE TO DECREASE EGT.

L PLACE SW-5 IN EGT AND SHUT DOWN ENGINE.

CAUTION

PLACE SW-6 IN MECH ZERO AND PLACE SW-1 OFF BEFORE REMOVING CABLES FROM ENGINE AND ANALYZER.

M REMOVE SWITCH BOX LEADS FROM ENGINE.

N CONNECT INDICATOR LEAD TO ENGINE ELECTRICAL DISCONNECT AND LOCKWIRE.

O ASSURE JETCAL ACCOMPLISHMENT IS RECORDED ON AFTO FORM 781N.

4C-2-8-(178-2)A

Figure 4-22. BH112J or JA Jetcal Analyzer - Exhaust Gas Temperature Adjustment (Jetcal Procedure IV) (Sheet 2 of 2)

4-137A. BH112JB-40 Jetcal Analyzer/Trimmer - Engine Speed Adjustment.

The engine speed adjustment procedure is to be performed when engine idle speed or top speed is not within the tolerance bands specified in section II. The throttle system must be correctly rigged before performing this procedure. The analyzer/trimmer displays actual engine speed in percent of RPM, and is accurate within one half of one percent. Correct engine speed is obtained by adjusting the engine speed to the percent of RPM displayed on analyzer/trimmer. Do not adjust engine result. Actual engine speed is set at IDLE and MIL power by turning the IDLE and MAX speed adjustment screws which are located on main fuel control. See figure 4-22A.

Tools and Equipment..

Jetcal analyzer/trimmer, BH112JB-40
Adapter, RPM check, BH907
Cable, instrument, BH485
Power source, external electrical 115Vac, 50 to 400 Hz single phase

Materials.

Lockwire, MS20995NC20

Manpower Requirements.

Two men reqiured.

Procedure	Normal Indication	Remedy for Abnormal Indication

WARNING

To prevent injury to personnel, make sure safety struts are installed on door 81 L and R actuators. Doors will close if electrical power is interrupted with hydraulic power applied.

CAUTION

Aircraft throttle system must be correctly rigged before performing this check.

Procedure	Normal Indication	Remedy for Abnormal Indication
a. Open doors 73L and 74L or door 74R.		
b. Make sure initial check of analyzer/trimmer has been performed. Refer to para 2-80B.		
c. Position switches as follows:		
(1) On trim Module Panel		
(a) MASTER POWER switch - off		
(b) STD DAY switch - OFF		
(c) RPM switch - N2		
d. Remove lockwire and disconnect engine tachometer generator electrical connector.		
e. Connect RPM check adapter BH907 to tachometer generator receptacle and electrical connector.		
f. Connect remaining end of RPM check adapter cable to instrument cable BH485.		
g. On trim module panel, connect remaining end of instrument cable to RPM INPUT INSTRUMENT CABLE receptacle.		

NOTE

A 15 minute warmup time is required to prevent incorrect readings during operation.

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
h. On trim module panel, turn MASTER POWER switch to on. Allow 15 minutes warmup time.	POWER ON light comes on and % RPM display reads 0% RPM.	1. Make sure power cable is connected to external electrical power source. 2. Check lamp. Replace if defective. 3. Check fuse. Replace if defective. 4. Return analyzer/trimmer for repair and/or calibration.

CAUTION

To prevent incorrect engine speed, do not adjust MFC to cockpit tachometer indication. Engine speed must be set only while viewing % RPM display on analyzer/trimmer.

NOTE

Turn IDLE speed adjustment screw on MFC clockwise to increase idle speed, or counterclockwise to decrease idle speed.

One click changes idle speed approximately 25 RPM. One full turn (15 clicks) equals approximately 5 percent RPM.

Procedure	Normal Indication	Remedy for Abnormal Indication
i. Start engine and stabilize at IDLE. Refer to TO 1F-4C-2-8CL-1.	1. Analyzer/trimmer % RPM display reads 64 to 66.	1. While monitoring analyzer/trimmer % RPM display, adjust MFC IDLE adjustment screw to obtain 64 to 66 percent. 2. If IDLE speed tolerance cannot be obtained by adjusting IDLE screw on MFC, refer to para 2-114.

NOTE

Engine speed can be adjusted to high or low side of tolerance band to bring cockpit indicator within limits.

Procedure	Normal Indication	Remedy for Abnormal Indication
	2. Front and rear cockpit tachometer indicators read 64 to 66 percent.	Perform tachometer system check, refer to para 2-80J.

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication

CAUTION

Avoid engine overspeed and overtemperature.

Engine speed adjustments must be made in IDLE speed only.

To prevent incorrect engine speed, do not adjust MFC to cockpit tachometer indication. Engine speed must be set only while viewing % RPM display on analyzer/trimmer.

NOTE

When outside temperature is below 45°C (114°F) engine top speed will not reach 100 percent RPM.

Turn MAX speed adjustment screw on MFC clockwise to increase top speed, or counterclockwise to decrease top speed.

One click changes top speed approximately 9 RPM. One full turn (15 clicks) equals approximately 2 percent RPM.

Procedure	Normal Indication	Remedy for Abnormal Indication
j. Advance throttle to MIL power and stabilize.	1. Analyzer/trimmer % RPM display reads within limits specified in fig 2-11.	1. Compute top speed adjustment based on analyzer/trimmer RPM indication. 2. Return throttle to IDLE power, and turn MFC MAX speed adjustment screw to predetermined setting. 3. Advance throttle to MIL power and make sure analyzer/trimmer % RPM display reads within limits specified in fig 2-11. 4. Repeat steps 1 thru 3 as required. 5. If top speed cannot be adjusted within limits, refer to para 2-106 or 2-107.

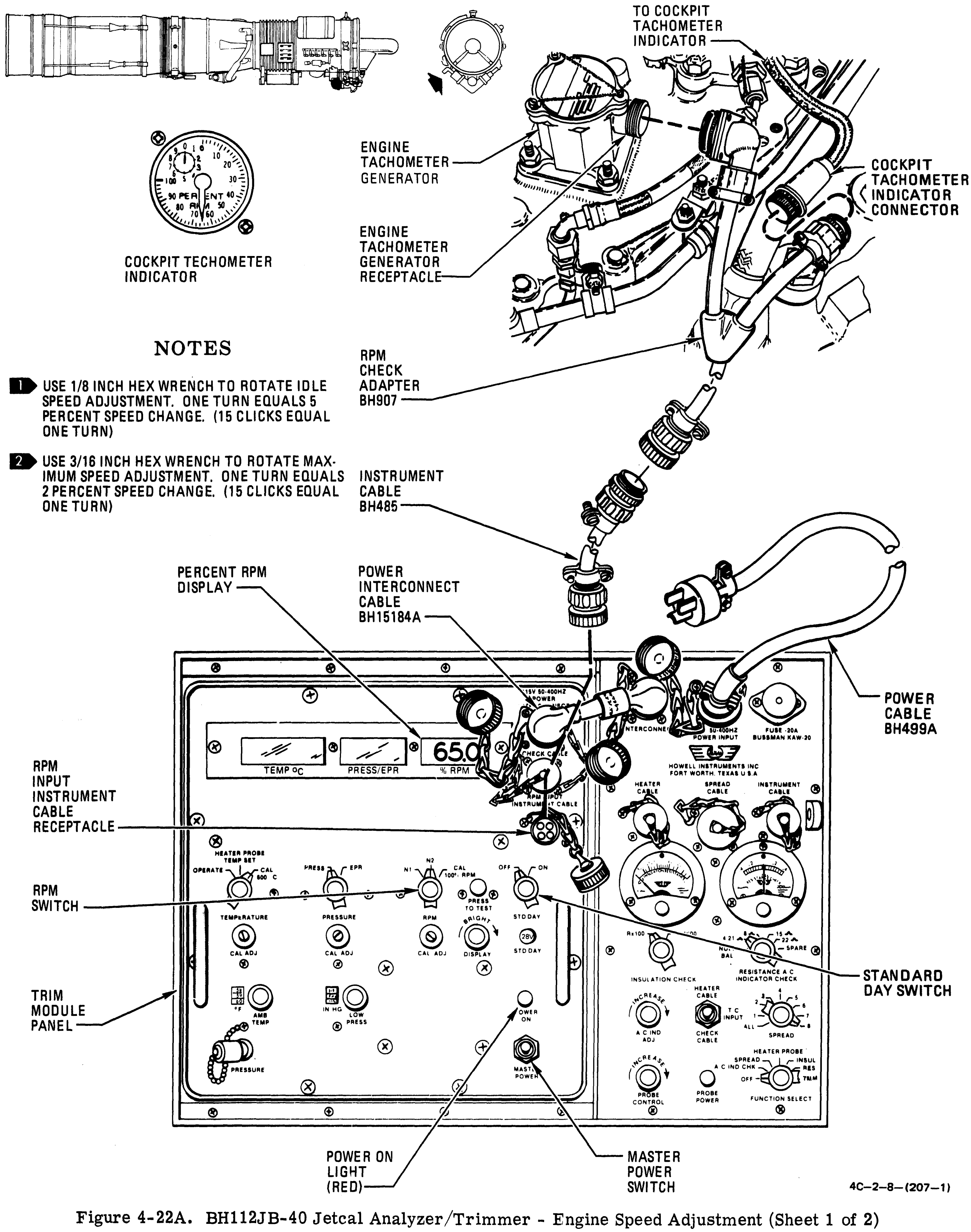
NOTE

Engine speed can be adjusted to high or low side of tolerance band to bring cockpit indicator within limits.

Procedure	Normal Indication	Remedy for Abnormal Indication
	2. Front and rear cockpit tachometer indicators read within limits specified in fig 2-11 and is within ±0.5 percent of RPM indicated on analyzer/trimmer.	Perform tachometer system check, refer to para 2-80J.
k. Shut down engine. Refer to TO 1F-4C-2-8CL-1.		
l. On trim module panel, position MASTER POWER switch to off and RPM switch to CAL 100% RPM.	All lights and displays go out.	

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
m. Remove RPM check adapter from tachometer generator receptacle and tachometer generator electrical connector.		
n. Connect tachometer indicator electrical connector to engine tachometer generator receptacle and lockwire.		
o. Remove RPM check adapter from instrument cable.		
p. Remove instrument cable from analyzer/trimmer.		
q. *Close doors 73L and 74L or door 74R.*		
r. *Record Jetcal accomplishment on aircraft forms.*		

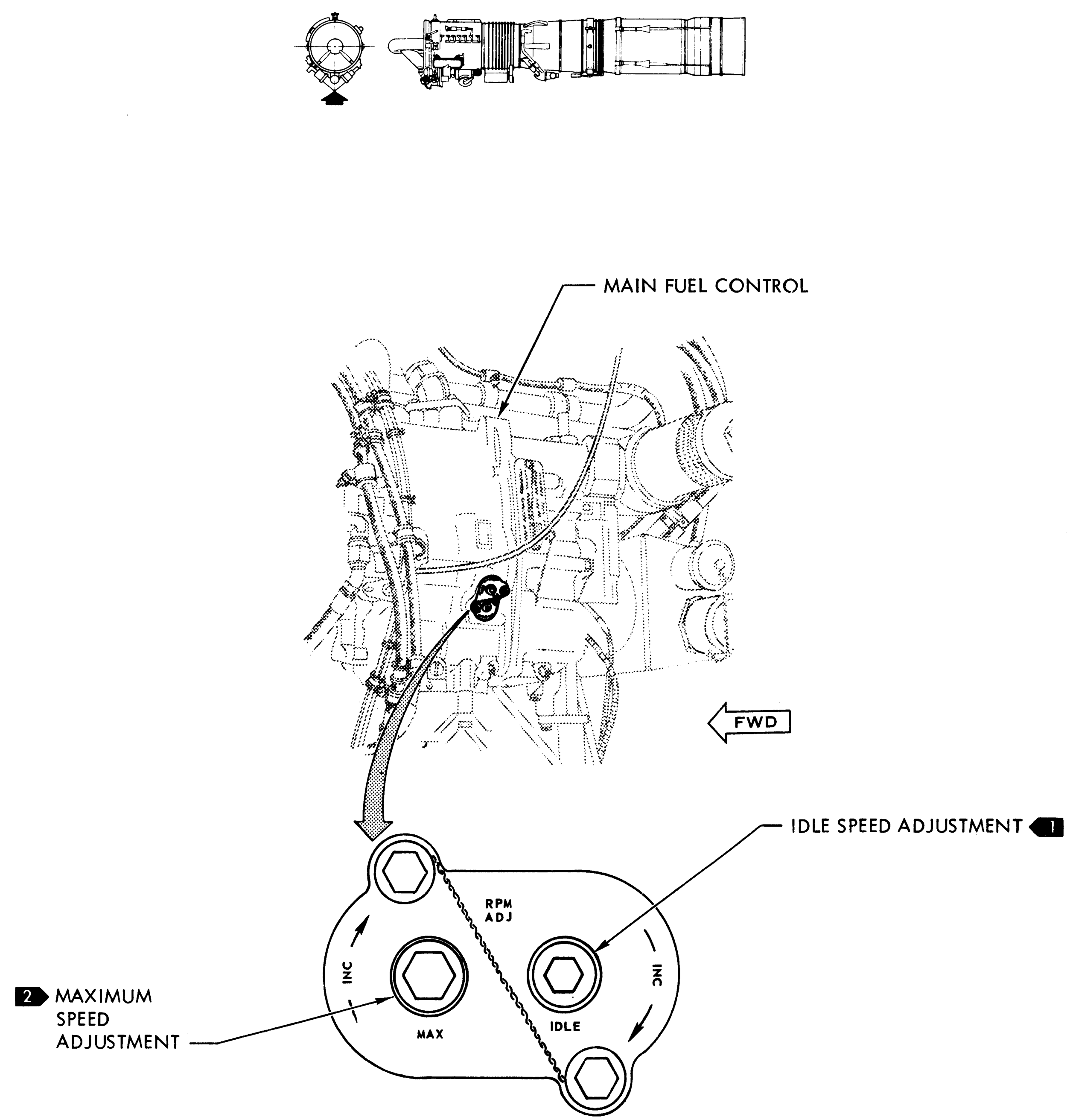


NOTES

1. USE 1/8 INCH HEX WRENCH TO ROTATE IDLE SPEED ADJUSTMENT. ONE TURN EQUALS 5 PERCENT SPEED CHANGE. (15 CLICKS EQUAL ONE TURN)

2. USE 3/16 INCH HEX WRENCH TO ROTATE MAXIMUM SPEED ADJUSTMENT. ONE TURN EQUALS 2 PERCENT SPEED CHANGE. (15 CLICKS EQUAL ONE TURN)

Figure 4-22A. BH112JB-40 Jetcal Analyzer/Trimmer - Engine Speed Adjustment (Sheet 1 of 2)



MAIN FUEL CONTROL SPEED ADJUSTMENT

4C—2—8—(207—2)

Figure 4-22A. BH112JB-40 Jetcal Analyzer/Trimmer - Engine Speed Adjustment (Sheet 2 of 2)

4-137B. BH112JB-40 Jetcal Analyzer/Trimmer - Exhaust Gas Temperature Adjustment.

The engine exhaust gas temperature must be accurate within prescribed limits to obtain maximum performance, and reliability. The Jetcal analyzer/trimmer is used in this procedure to make the final exhaust gas temperature adjustment during engine run. This procedure is not intended to replace the EGT system checks. If the EGT, as read on the Jetcal analyzer/trimmer, falls outside the tolerance bands in section II, a complete EGT system functional check is required and system error corrected before temperature adjustments are made. If EGT falls within the tolerance bands, temperature adjustment is allowed without performing a complete system functional check. See figure 4-22B.

Tools and Equipment.

Jetcal analyzer/trimmer, BH112JB-40
Cable, check, BH450
Adapter Y, BH10038
Power source, external electrical 115Vac, 50 to 400 Hz, single phase.

Materials.

Lockwire, MS20995NC20

Manpower Requirements.

Two men required.

Procedure	Normal Indication	Remedy for Abnormal Indication
WARNING To prevent injury to personnel, make sure safety struts are installed on door 81L and R actuators. Doors will close if electrical power is interrupted with hydraulic power applied. **CAUTION** This procedure is to be used only during final EGT adjustment. Under no circumstances is it to replace an EGT system functional check.		
a. Make sure safety struts are installed on door 81L and R actuators. Disconnect actuator from door 81L or R and open door 82L if left engine is to be adjusted.		
b. Make sure initial check of the analyzer/trimmer has been performed. Refer to para 2-80B.		
c. Position controls as follows:		
(1) On Trim Module Panel		
(a) MASTER POWER switch - off		
(b) TEMPERATURE switch - OPERATE		
d. Remove lockwire and disconnect aircraft EGT indicator connector from engine electrical disconnect bracket.		
e. Connect one end of Y adapter BH10038 to engine thermocouple receptacle on engine electrical disconnect bracket.		
f. Connect one end of Y adapter to aircraft EGT indicator connector.		
g. Connect check cable BH450 to remaining end of Y adapter and to CHECK CABLE receptacle on trim module panel.		

CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication

NOTE

A 15 minute warmup time is required to prevent incorrect readings during operation.

Procedure	Normal Indication	Remedy for Abnormal Indication
h. On trim module panel, position MASTER POWER switch to on. Allow 15 minutes warmup time.	POWER ON light comes on and TEMP°C display drifts upscale out of range.	1. Make sure power cable is connected to external electrical power source. 2. Check lamp. Replace if defective. 3. Check fuse. Replace if defective. 4. Return analyzer/trimmer for repair and/or calibration.

NOTE

The cockpit EGT indicator must always be used during transient conditions to allow engine operator to monitor EGT.

i. Start engine and stabilize at MIL. Refer to TO 1F-4C-2-8CL-1.

CAUTION

To prevent incorrect engine EGT, do not adjust temperature amplifier to cockpit EGT indication. EGT must be set only while viewing TEMP°C display on analyzer/trimmer.

NOTE

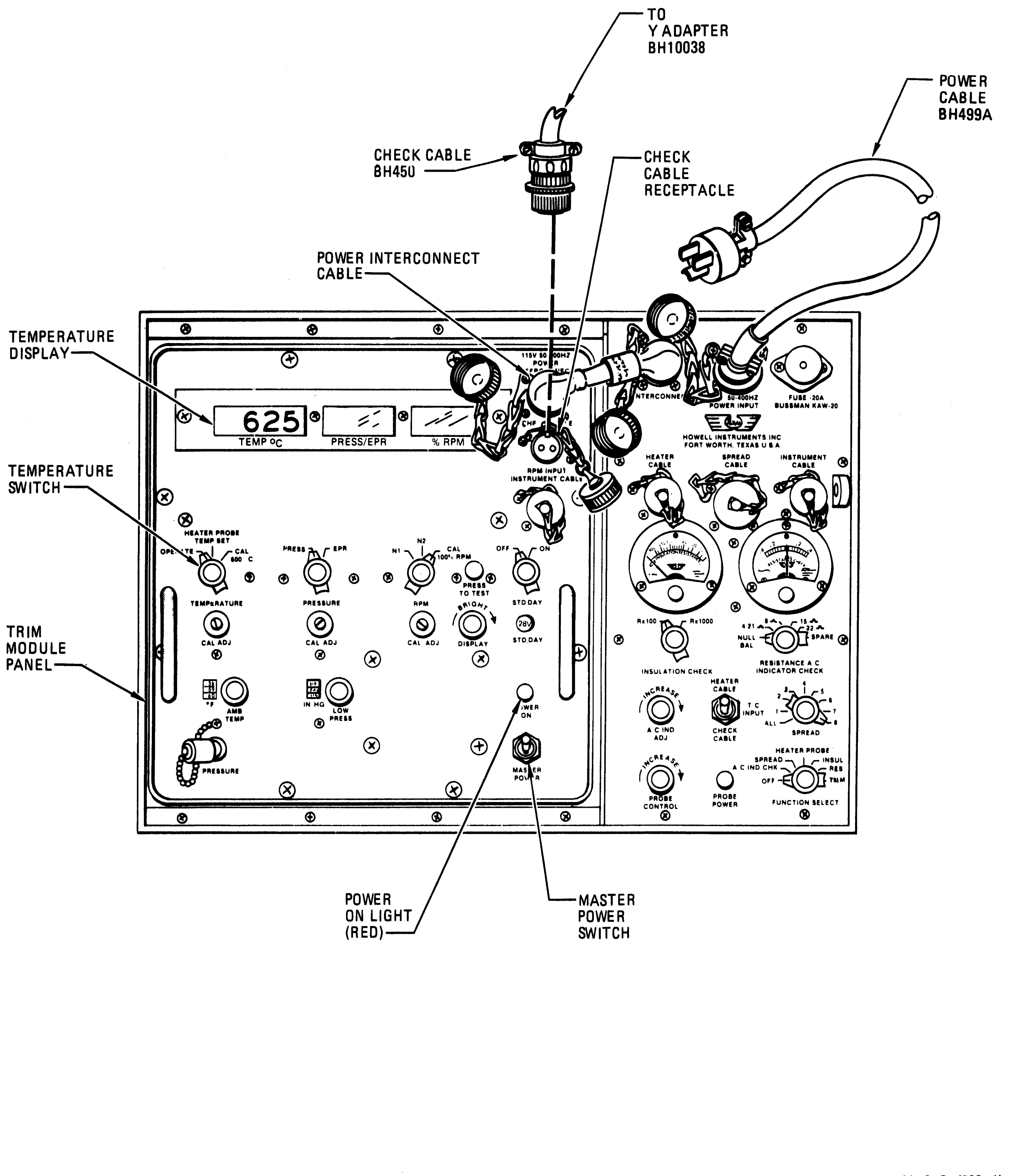
One click of reference temperature adjustment screw on temperature amplifier equals 0.73°C.

Turn reference temperature adjustment screw clockwise to increase EGT or counterclockwise to decrease EGT.

Procedure	Normal Indication	Remedy for Abnormal Indication
j. Record TEMP°C display reading on analyzer/trimmer.	1. Analyzer/trimmer TEMP°C display reads 625°.	1. If TEMP°C display reading is not within tolerence bands in fig 2-11, refer to para 2-89 or 2-90. 2. If TEMP°C display reads within tolerance bands, compute required EGT adjustment to bring EGT indication on analyzer/trimmer to 625°C. Record number of clicks required. 3. Return throttle to IDLE and turn reference temperature adjustment screw on temperature amplifier number of clicks computed in step 2.

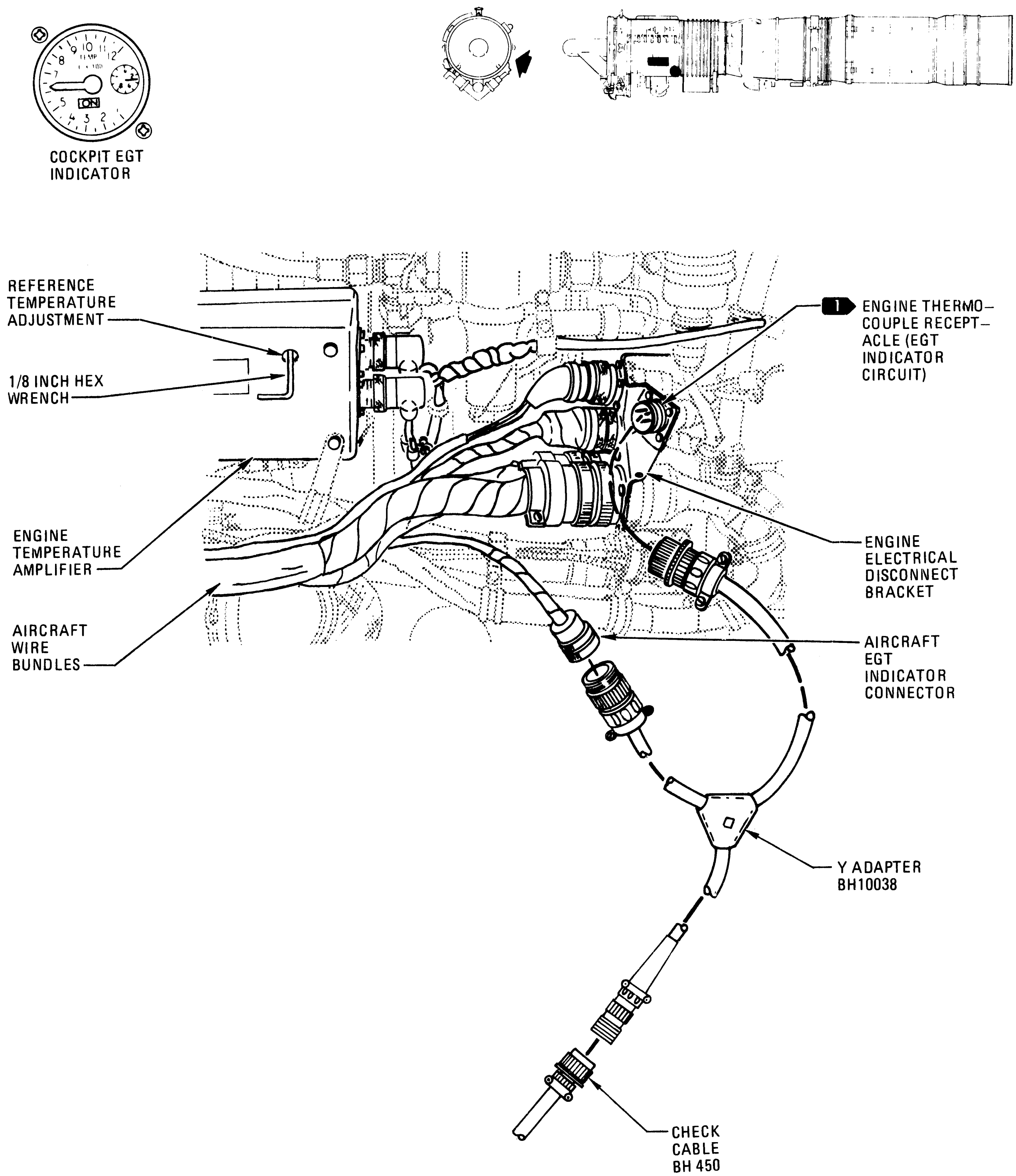
CONTINUED

Procedure	Normal Indication	Remedy for Abnormal Indication
CAUTION To prevent engine damage, do not allow EGT to exceed temperature limits.		
		4. Advance throttle to MIL. 5. Make sure analyzer/trimmer TEMP°C display reads 625°C. 6. Repeat steps 2 through 5 as required. 7. If EGT still cannot be adjusted, slave in a known good temperature amplifier.
k. If EGT adjustment was required; record TEMP°C display reading on analyzer/trimmer.		
l. Compare cockpit EGT indicator reading with TEMP°C display reading on analyzer/trimmer.	Cockpit EGT indicator reads within ±5°C of TEMP°C display reading obtained in step j or k.	Perform EGT indicator check. Refer to para 2-80H.
m. Shutdown engine. Refer to TO1F-4C-2-8CL-1.		
n. On trim module panel, position MASTER POWER switch off.	All lights and displays go out.	
o. Connect actuator on door 81L or R or close door 82L if left engine was adjusted.		



4C-2-8-(208-1)

Figure 4-22B. BH112JB-40 Jetcal Analyzer/Trimmer - Exhaust Gas Temperature Adjustment (Sheet 1 of 2)



NOTE

1 RECEPTACLE LOCATED ON CANTED FACE OF ENGINE ELECTRICAL DISCONNECT BRACKET.

4C–2–8–(208–2)

Figure 4-22B. BH112JB-40 Jetcal Analyzer/Trimmer - Exhaust Gas Temperature Adjustment (Sheet 2 of 2)

4-138. CLEANING, DRAINING AND LUBRICATION.

4-139. CLEANING.

4-140. Deleted.

4-141. **Torque Booster Fuel Filter.** See figure 4–23.

4-142. **Nozzle Feedback Cables and Conduits.**

4-143. **Materials.**

Solvent, P-D-680, Type II

4-144. **Procedure.** Clean cables and conduits with solvent, P–D–680, or equivalent. Do not vapor degrease cables as this removes internal lubrication.

4-145. **Airframe Power Plant Control System Teleflex Cables.**

WARNING

To prevent injury to personnel, use cleaning solvent in a well ventilated area. Avoid prolonged breathing of fumes. Keep away from flame.

CAUTION

To avoid damage to equipment, only authorized cleaning materials and methods shall be employed. Do not immerse the cable in solvent.

4-145A. **Materials.**

Solvent, P-D-680, Type II
or
Trichloroethylene, O-T-634 Type II
or
Trichloroethane, O-T-620 Type II

4-146. **Procedure.**

a. Clean teleflex cables by the solvent vapor degreasing method if available. Allow cable to remain in degreaser from 3 to 5 minutes. If vapor degreasing facilities are not available, clean cable with P-D-680, type II solvent and brush.

b. Remove any hardened deposits of grease or dirt with soft fiber or wire brush.

c. Wipe cable with soft cloth moistened with P-D-680, Type II solvent.

4-147. LUBRICATION.

4-148. **Nozzle Feedback Cables.**

4-149. **Materials.**

Anti–seize compound, Molykote M–77
Silicone grease, Dow Corning No. 33
Oil, MIL–L–6081 Grade 1010

4-150. **Procedure.**

a. Soak Teleflex cables in oil at 145° to 155°F for 30 minutes.

b. Flex cables occasionally to insure adequate oil penetration.

NOTE

Molykote M–77 is preferred lubricant. If M–77 is not available, Electro–Moly/40 may be used. Do not dilute lubricant, but mix thoroughly before use.

c. Apply anti–seize compound to cables with fingertips using rubber gloves. Work compound to fill spaces between the helix wires of cables. Approximately 2 to 3 ounces of molykote compound will be consumed during application of compound to cables.

NOTE

M–77 lubricant may tend to dry out and harden somewhat due to heat. However, lubricating qualities are not impaired and removal and replacement of hardened M–77 is unnecessary.

Do not apply anti–seize compound to forward 12 inches of forward nozzle feedback cable or to aft 12 inches of aft nozzle feedback cable.

d. Wipe excess anti–seize compound from disconnect unit and nozzle feedback control box.

e. With disconnect cover and backup cover still removed, cycle feedback cable system by alternately pulling and pushing clevis on telescopic unit approximately 12 inches for 5 times.

f. Wipe excess anti–seize compound from disconnect unit and nozzle feedback control box.

4-151. **THROTTLE INPUT AND VARIABLE VANE FEEDBACK LINKAGE.**

4-151A. **Materials.**

Grease, Silicone Dow Corning 33 Light MIL–G-25013D
Oil, MIL–L–6081 Grade 1010

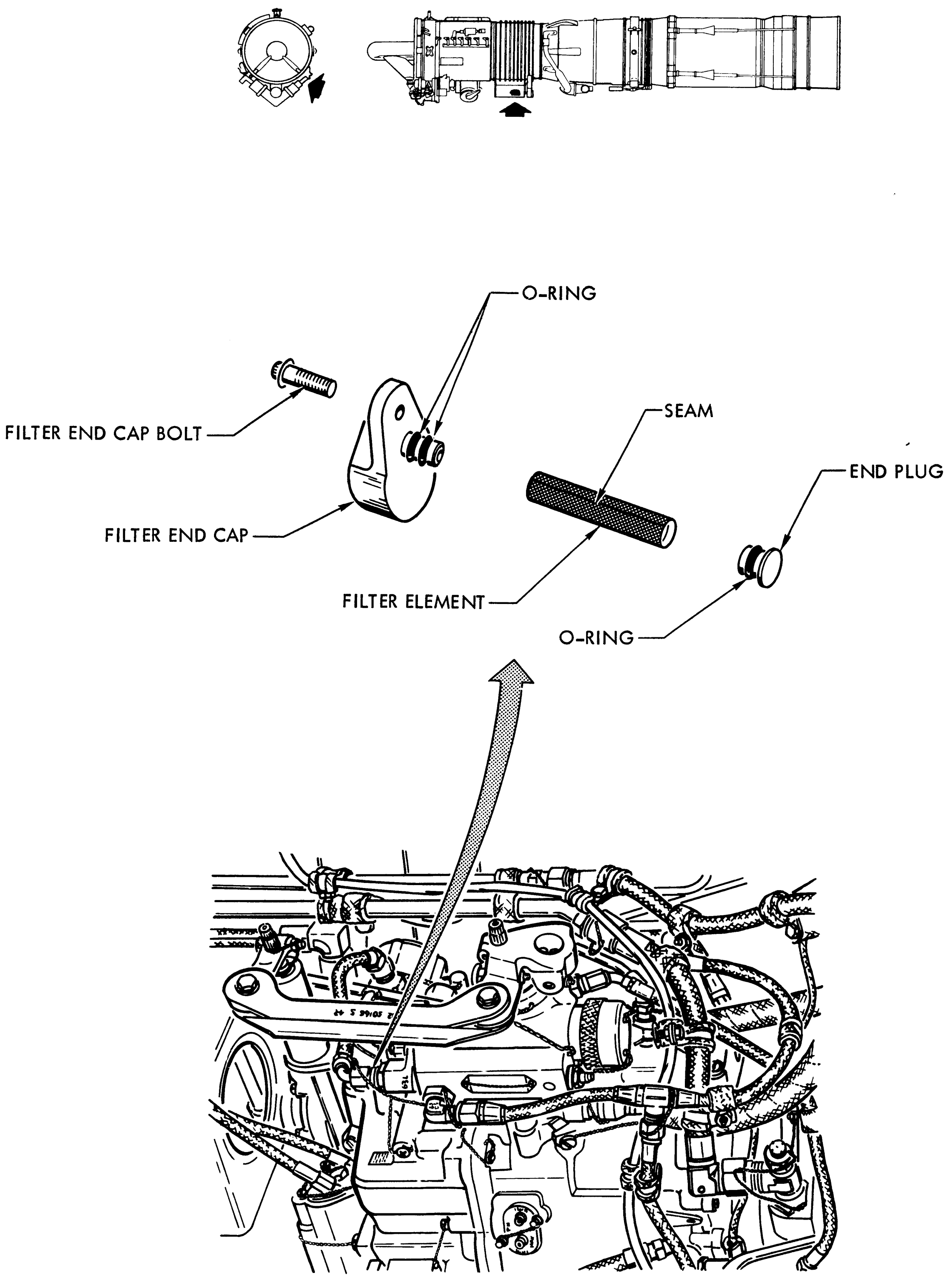
4-151B. **Procedure.**

a. Lubricate Teleflex cables by soaking in oil at 145° to 155°F for 30 minutes.

b. Flex cables occasionally to insure adequate oil penetration.

c. Lubricate cables lightly with silicone grease.

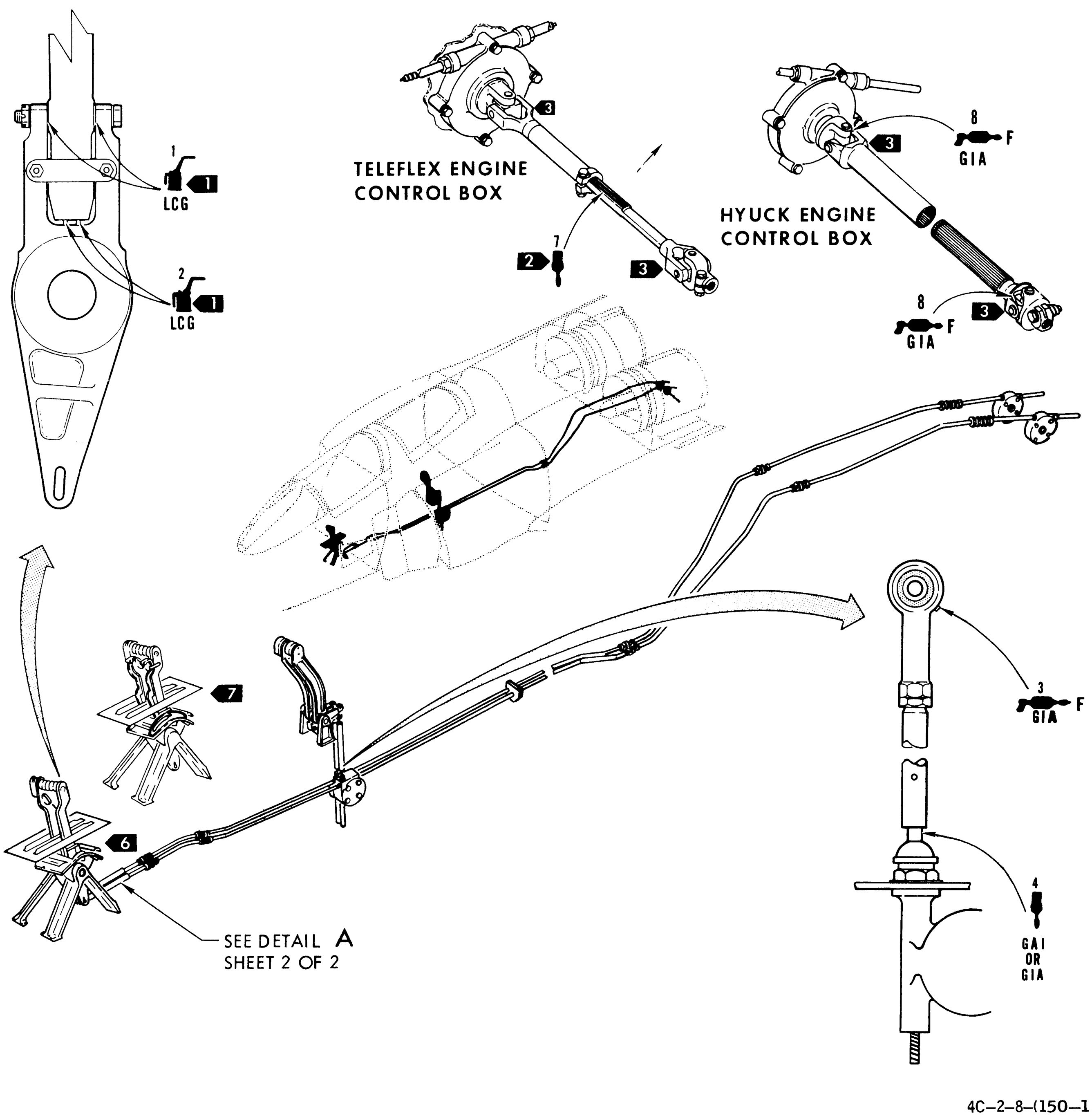
4-152. **Airframe Power Plant Control System.** See figure 4-24.



4C-2-8-(119)

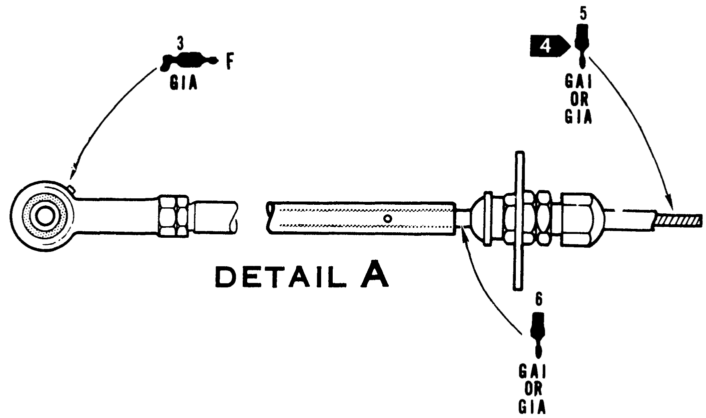
Figure 4-23. Torque Booster Fuel Filter

1.	LEVER PIVOT BOLT
2.	SHIFT LINKS
3.	ROD END BEARINGS
4.	RADAR PILOTS TELESCOPIC UNITS 204AA3M3 (L) 204AA3M4 (R)
5.	TELEFLEX CABLE
6.	PILOTS TELESCOPIC UNIT 204AA2M3 (L) 204AA2M4 (R)
7.	ENGINE CONTROL BOX TORQUE SHAFT
8.	ENGINE CONTROL BOX UNIVERSALS



4C-2-8-(150-1)

Figure 4-24. Airframe Power Plant Control System Lubrication (Sheet 1 of 2)



NOTES

1. USE CARE WHEN APPLYING WET FILM LUBRICANT IN THIS AREA TO KEEP IT FROM GETTING ON THE QUADRANT SHAFT OR LOWER LEVEL BUSHINGS. THE SHAFT HAS DRY FILM LUBRICANT APPLIED AND APPLICATION OF WET FILM LUBRICANT WILL INDUCE GALLING OF THE DRY FILM LUBRICANT AND CAUSE FRICTION ADJUSTMENT DIFFICULTY.
2. LUBRICATE TORQUE SHAFT WITH LUBRICATING GREASE (MIL-L-15719).
3. LUBRICATE UNIVERSALS ON HYUCK BOX. DO NOT LUBRICATE UNIVERSALS ON TELEFLEX BOX.
4. LUBRICATE TELEFLEX CABLES WITH MIL-G-23827.
5. OUTSIDE DIAMETER OF PLAIN UNLINED CONDUIT IS 0.271 IN. AND TEFLON CONDUIT 0.300 IN.
6. BEFORE T.O. 1F-4-860.
7. AFTER T.O. 1F-4-860.

APPLICATION SYMBOLS

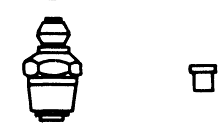
---DASHED LINES INDICATE LUBRICATING POINTS ON OPPOSITE SIDE

TABLE OF LUBRICANTS

SYMBOL	SPEC.	TYPE
GAI........ (BEING REPLACED BY MIL-G-23827)	MIL-G-7421	GREASE, AIRCRAFT AND INSTRUMENT, EXTREME LOW TEMPERATURE
GIA	MIL-G-23827....	GREASE, AIRCRAFT AND INSTRUMENT (FOR LOW AND HIGH TEMPERATURES)
LCG.......	MIL-L-3572.....	LUBRICANT, COLLOIDAL GRAPHITE IN OIL
	MIL-L-15719. .	LUBRICATING GREASE, HIGH TEMPERATURE
DC33		DOW CORNING SILICONE

FITTING TYPE

BALL TYPE	FLUSH TYPE
B	F



4C-2-8-(150-2)

Figure 4-24. Airframe Power Plant Control System Lubrication (Sheet 2 of 2)

SHOP MAINTENANCE

4-153. MAINTENANCE PROCEDURES.

4-154. This section provides maintenance procedures applicable to components/systems when removed from the aircraft. Table 4-3 lists the functional line replaceable units (LRU) of the system with the location of applicable maintenance procedures. Shop maintenance procedures, when contained in this manual are referenced by paragraph numbers; when contained in accessory publication, the T.O. numbers of the applicable manuals are listed. Manuals in the F-4 series or in general aircraft series are listed when containing procedures directly applicable to the LRU. When separate overhaul/illustrated parts breakdown manuals have been provided, the T.O. numbers are listed.

Table 4-3. Line Replaceable Units

Line Replaceable Unit	Manufacturers Part Number	Applicable Maintenance Procedures/Publications Shop (Intermediate Level)	Applicable Maintenance Procedures/Publications Overhaul/IPB
Forward cockpit throttle quadrant	32-54000	Paragraph 4-168	
Aft cockpit throttle quadrant	53-54000	Paragraph 4-159	
Engine control box	20537-1 20537-2 169-1-000		T.O.2JA12-4-3, -4 T.O.2JA12-4-3, -5 T.O.16R1-3-30-3
Dual control box	20536 170-1-000		T.O.2JA12-4-3, -4 T.O.16R1-3-30-3
Torque booster	512D831P7		T.O.2J-J79-46, -44

4-155. **PACKAGING.** Components to be forwarded to the next higher level of maintenance for repairs, test, or check must be cleaned, preserved and packaged for protection against physical and mechanical damage during subsequent handling, shipping and storage. For preservation and packaging methods referred to herein, refer to AFP 71-4 volumes 1 and 2. Components packed for forwarding must further be identified, marked and documented in accordance with applicable Air Force procedures.

Paragraphs 4-156 thru 4-158 deleted.

4-159. **AFT COCKPIT THROTTLE QUADRANT.** See figure 4-25.

4-160. **Tools and Equipment.**

Scale, spring
Scale, push-pull

4-161. **Materials.**

Compound, sealing and retaining MIL-S-22473, Grade C
Compound, sealing and retaining MIL-S-22473, Grade N

4-162. **Disassembly.**

a. Remove four screws (1) attaching electrical receptacle to channel.

b. Remove two channel attaching bolts (2) from inboard support and remove bolt (3) attaching the support to tube.

c. Remove support from tube (4) and remove throttle levers.

d. Disengage throttle lever load limiters.

e. Depress load limiter plunger (5) and remove spring pin (6) from lever slot. Slowly release plunger and remove plunger, spring (8) and washers (7).

4-163. **Inspection.**

a. Check lever bearings (9) for evidence of roughness.

b. Check load limiter plunger for nicks and scratches in area where plunger contacts lever bellcrack (10).

c. Check electrical recptacle for bent pins or corrosion.

4-164. **Right Throttle Lever Switch Removal.**

a. Remove MIC switch cap, screw cap and shaft from switch.

b. Remove SPEED BRAKE switch cap, remove screw in center of cap and pull cap from shaft.

c. Remove three screws that retain grip to throttle lever and remove plate.

d. Remove two screws retaining each switch to grip and remove switch.

e. Remove wires from switch.

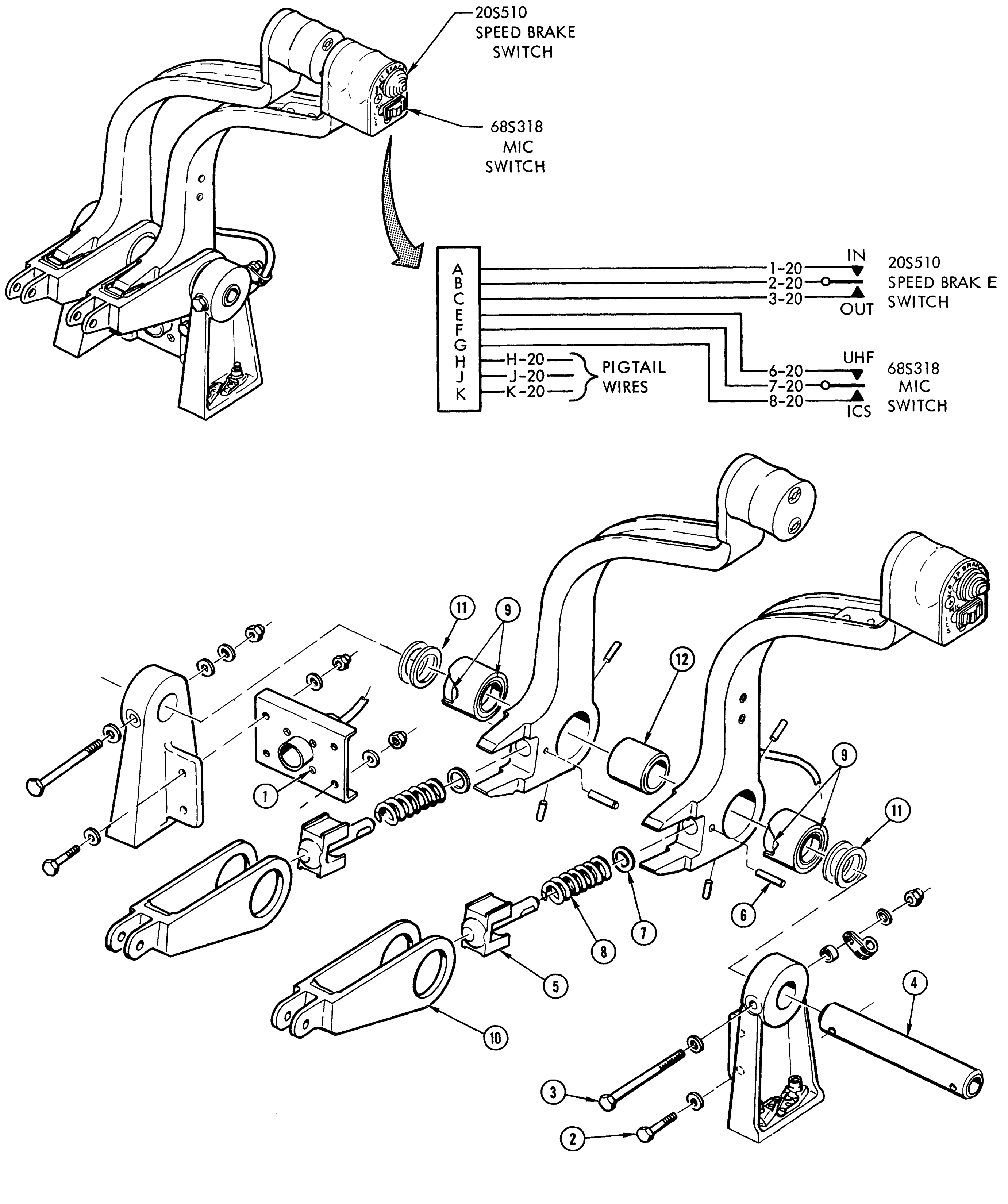


Figure 4-25. Aft Cockpit Throttle Quadrant

4-165. Right Throttle Lever Switch Installation.

a. Connect wires to switch.

b. *Install two screws that retain switch to grip and safety screws with MS20995NC20 lockwire.*

c. Install grip to throttle lever and install three retaining screws. *Torque screws 13 to 15 inch-pounds.*

d. Apply sealing and retaining compound to switch caps.

e. Install SPEED BRAKE switch cap, install and tighten retaining screw.

f. Screw MIC switch cap on switch shaft.

4-166. Assembly.

NOTE

Do not lubricate quadrant.

a. Install load limiter spring (8), washer (7) and plunger (5). Depress plunger and install spring pin (6).

b. Engage load limiter.

c. Install throttle levers, bushings (11 and 12), and support to tube (4). Install bolt (3) and attach bundle clamp.

d. Install two channel attaching bolts (2) and attach receptacle to channel.

e. Check load required, at hand grip, to disengage load limiters. *Load required should be 55 to 100 pounds.*

f. Position quadrant so lever motion is in a horizontal plane and check force required at hand grip, to move throttle levers throughout their entire range of travel. *The force required should not exceed 0.25 pounds.*

4-167. *Quality Assurance Summary.*

a. *Assure proper operation of load limiters.*

b. *Force required to move throttle levers is within limits.*

4-168. FORWARD COCKPIT THROTTLE QUADRANT AFTER T.O.1F-4-860. See figure 4-26.

4-169. Tools and Equipment.

Wrench, torque, 0 to 50 inch-pounds
Wrench, torque, 0 to 100 inch-pounds
Scale, spring, 0 to 40 pounds

4-170. Materials.

Compound, retaining, MIL-S-22473, (grade C)
Grease, MIL-L-3572
Solvent, P-D-680
Lockwire, MS20995NC20
Pin, cotter MS24665-136

4-171. Disassembly.

a. Remove two terminal board covers (1).

b. Remove guards (9) from throttle cutoff switches (10) and disconnect wires from terminal boards and throttle cutoff switches.

c. Remove terminal boards (2) and terminal strips (3).

d. Remove throttle cutoff switches (10) from switch support.

e. Remove cap screw (35) and bushing (36).

f. Remove idle stop cam plate (4).

g. Remove bolts attaching throttle cutoff switch support to outboard quadrant support (12).

h. Remove plates (6 and 7) from plate assembly (8).

i. Remove plate assembly (8) from quadrant supports (12 and 26).

j. Remove lever friction adjustment screws (50) from throttle levers (14 and 22).

k. Remove bolt (11) attaching outboard quadrant support (12) to shaft (25) and remove quadrant support.

l. Remove items (13 thru 16) in sequence. Remove cam (17), key (18), friction lever (19), cam (17), and key (18). Remove items (20 thru 25) in sequence.

4-172. Disassembly of Left Lever Assembly.

a. Remove bolts, nuts and washers (51), plates (34 and 38), and wire bundle clamp.

b. Remove bolt (33) and separate upper arm (32) from lower arm (27). Retain springs (28) and washers (29). Record number of washers for assembly.

c. Remove screws (44) attaching knob (45) to arm (32).

d. Disconnect wires from switch (46) and remove switch from arm (32).

e. Remove ignition switch housing (47) and disconnect wires from switch (48). Remove switch.

f. Remove screws (40) from guide (41) and remove guide.

g. Remove finger lift (42).

h. Remove pin (31) and remove links (30) from arm (32).

i. Remove adjustment bolt (77) from arm (27).

4-173. Disassembly of Right Lever Assembly.

a. Remove screws (71), stop plates (72), and wire bundle clamp from lever assembly (22).

b. Remove bolt (80) and separate upper throttle arm (52) from lower arm (76). Retain springs (69) and washers (70). Record number of washers for assembly.

c. Remove switch buttons (55 and 62). Remove screws (57 and 59), plate (61), and lever grip (53) to arm (42). Remove switch (56) from housing on plate (61).

d. Remove switches (55 and 54) from lever grip (53). Disconnect wires from speed brake switch (54) and microphone switch (55).

e. Remove screws (57) from guide (63) and remove guide.

f. Remove finger lift (64).

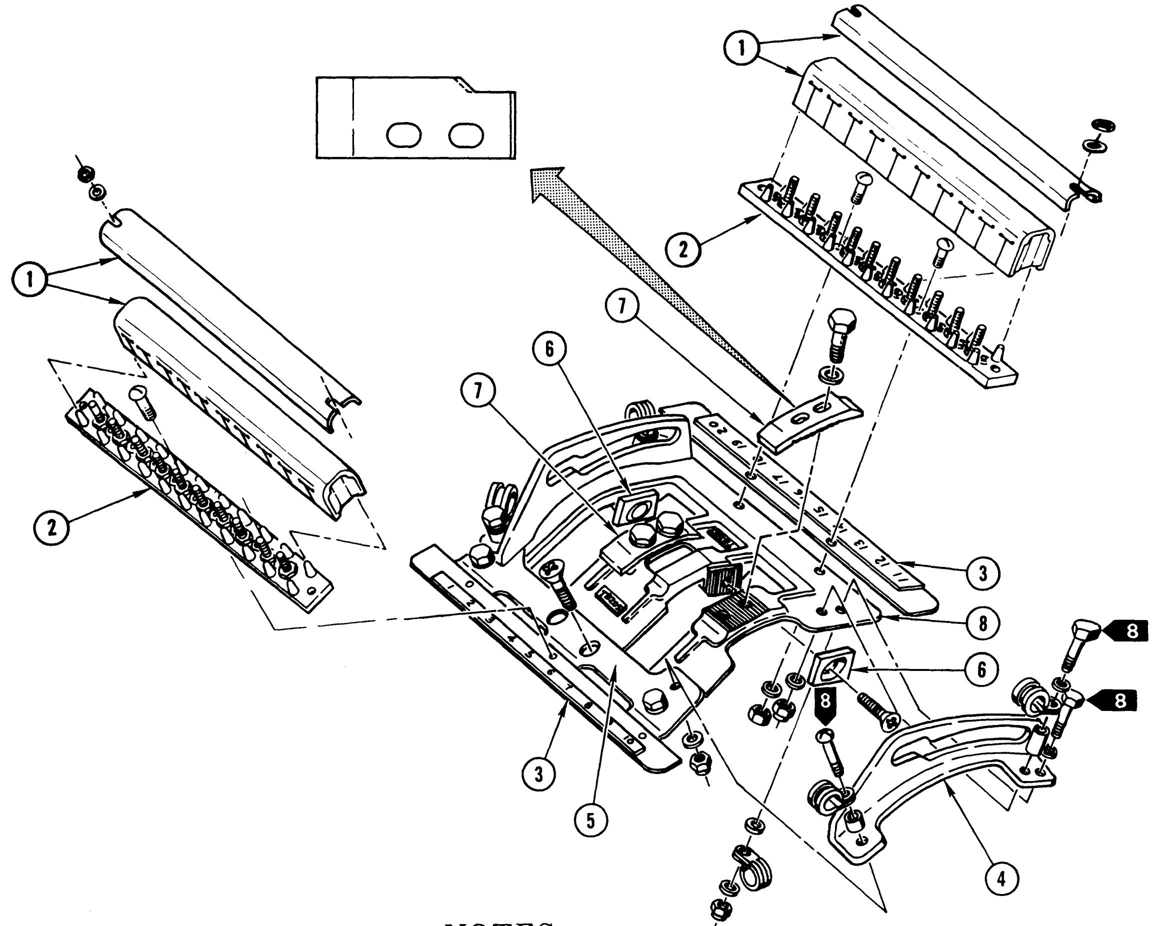
g. Disconnect wires from ignition switch (56) and remove switch from grip (53).

h. Remove adjustment bolt (77) from lower arm (76).

1. TERMINAL BOARD COVER
2. TERMINAL BOARD
3. STRIP ASSEMBLY
4. STOP CAM
5. PLATE (LEVER STOP)
14 6. PLATE (MIL POWER ADJ)
14 7. PLATE (THROTTLE SHIFTED ADJ MIL)
8. PLATE (QUADRANT CAM)
9. GUARD
14 10. SWITCHES, THROTTLE CUTOFF
11. BOLT, WASHER AND NUT
12. SUPPORT
13. WASHER
14. LEVER, LEFT THROTTLE ASSY
15. SPRING, FRICTION
16. WASHER
17. CAM, FRICTION ADJ
18. KEY, CAM
19. LEVER, FRICTION
20. WASHER
21. SPRING, FRICTION
22. LEVER, RIGHT THROTTLE ASSY
23. WASHER
24. BOLT, WASHER AND NUT
25. SHAFT
26. SUPPORT
27. ARM ASSY, LOWER LEVER
28. SPRINGS
29. WASHERS
30. LINKS
31. PIN
32. ARM ASSY, UPPER LEFT
33. BOLT, WASHER AND NUT
34. PLATE
35. CAP SCREW AND NUT
36. BUSHING
37. WASHER
38. PLATE
39. BUSHING
40. SCREWS
41. GUIDE
42. LIFT, FINGER
43. SPRING
44. SCREW
45. KNOB
46. SWITCH
47. HOUSING
48. SWITCH, IGNITION
49. WASHERS
14 50. SCREW, SPRING AND PLUG
51. BOLTS, NUTS, WASHERS AND CLAMPS
52. ARM ASSY, UPPER RIGHT
53. GRIP
54. SWITCH, SPEED BRAKE
55. SWITCH, MICROPHONE
56. SWITCH, IGNITION
57. NUT AND SCREW
58. SCREW
59. NUT AND SCREW
60. SCREW
61. PLATE
62. BUTTON, SP BRK SW
63. GUIDE
64. LIFT, FINGER
65. WASHERS
66. PIN
67. SPRING
68. LINKS
69. SPRINGS
70. WASHERS
71. SCREWS
72. PLATE
73. CAP SCREW AND NUT
74. BUSHINGS
75. WASHERS
76. ARM ASSY, LOWER LEVER
14 77. BOLTS, RADIUS ADJUST.
78. CLAMPS
15 79. CLAMPS, SPACERS AND BOLTS

4C-2-8-(158-1)

Figure 4-26. Forward Cockpit Throttle Quadrant Assembly and Adjustment – AFTER T.O.1F-4-860 (Sheet 1 of 6)



NOTES

1. POSITION WIRE TERMINALS WITHIN THE BARRIERS TO PROVIDE A MINIMUM CLEARANCE WITH BARRIER POSTS OF 0.03 INCH TO PROVIDE CLEARANCE FOR COVER INSTALLATION.

2 PROVIDE 4.50 ±0.10 INCH WIRE BUNDLE LENGTH BETWEEN FACES OF CLAMPS.

3 WIRE BUNDLE NOT TO EXTEND BEYOND EDGE OF TERMINAL BOARD COVER.

4 WIRE BUNDLE NOT TO EXTEND 0.10 INCH MAXIMUM BEYOND EDGE OF TERMINAL BOARD COVER.

5 VINYL COVERING ON WIRE BUNDLE TO EXTEND BEYOND OUTER MOUNTING BOLTS.

6 DELETED

7 SHIM STOPS FOR SHIFT THROW ANGLES, USE NAS 1197-10L WASHERS.

8 TORQUE NUTS TO 20-25 INCH-POUNDS.

9 APPLY A LIGHT FILM OF MIL-L-3572 OR MIL-L-15719 TO BOLT AND THROTTLE ARMS.

10 TIGHTEN NUT UNTIL ALL PARTS ARE IN CONTACT, THEN BACK OFF UNTIL UPPER ARM MOVES FREELY.

11 TORQUE TO 13-15 INCH-POUNDS.

12 APPLY RETAINING COMPOUND MIL-S-22473 TO THREADS OF SCREW.

13 USE AN960D10L WASHERS 3 MAX EACH PLACE TO OBTAIN 0.020 INCH CLEARANCE.

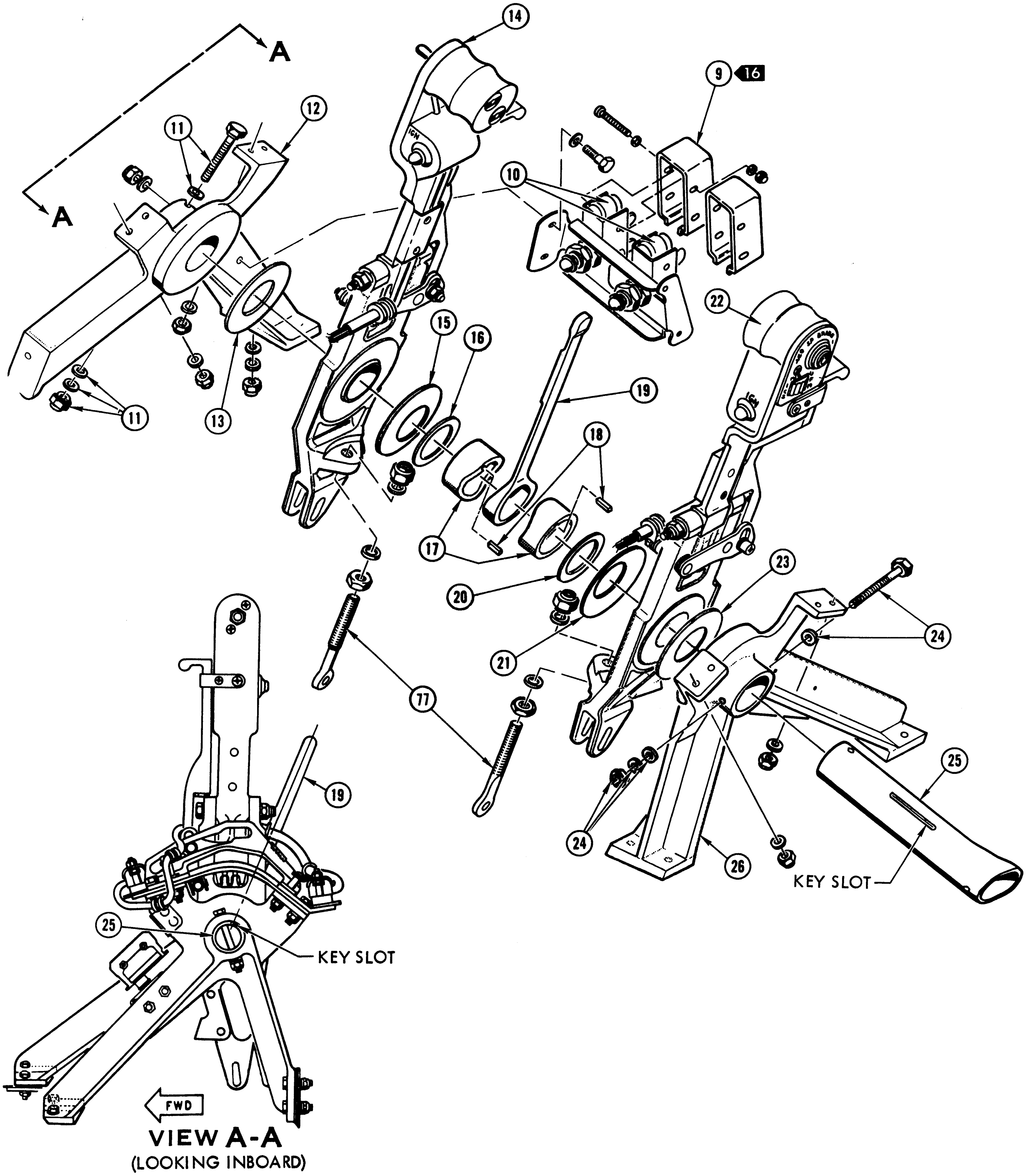
14 ADJUSTED DURING AIRFRAME POWER PLANT CONTROL SYSTEM RIGGING.

15 CLAMPS MUST BE BENT UP 35° BEFORE INSTALLING.

16 63-7598 AND UP; ALSO 63-7407 THRU 63-7597 AFTER T.O. 1F-4-942.

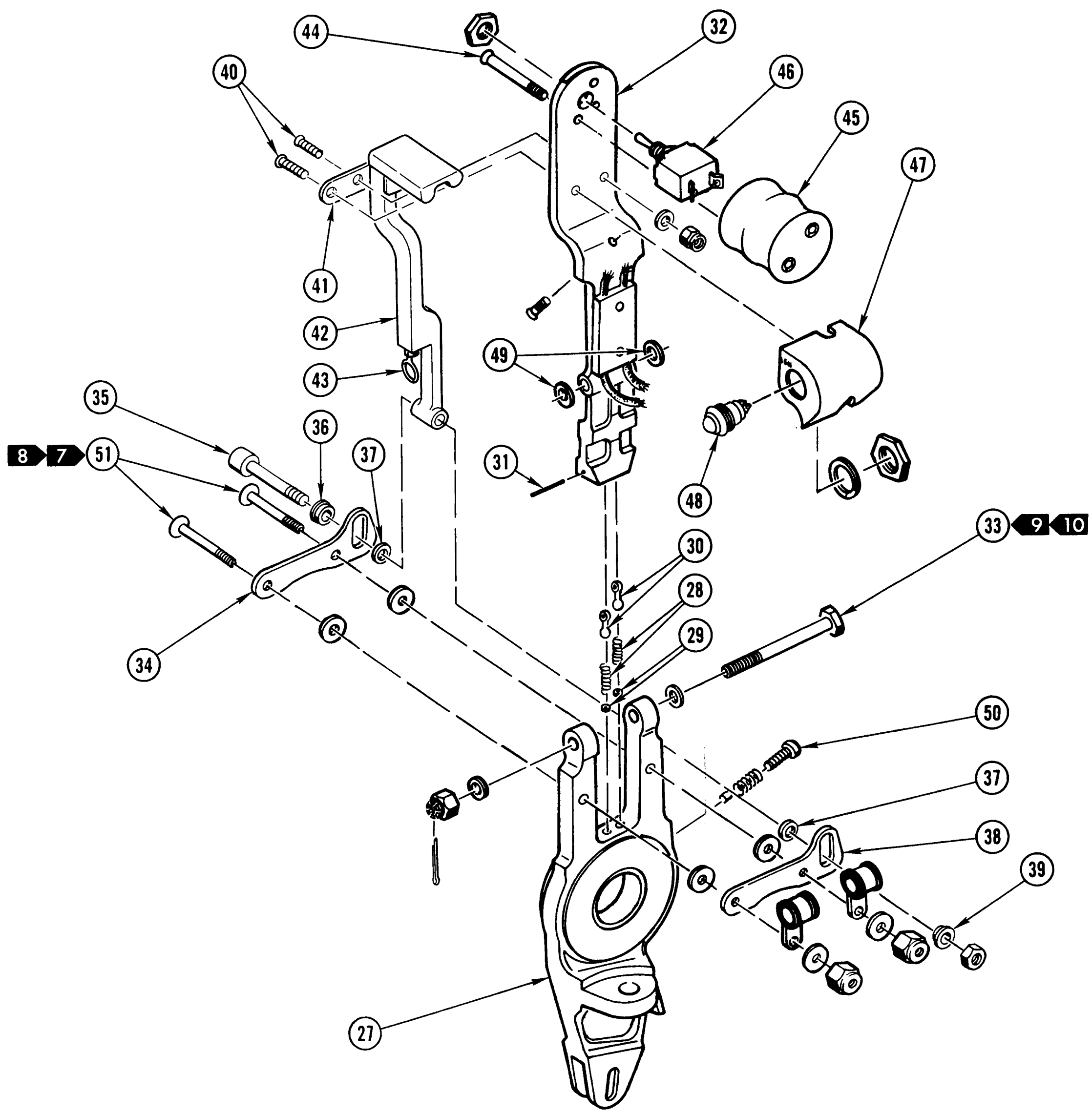
4C-2-8-(158-2)A

Figure 4-26. Forward Cockpit Throttle Quadrant Assembly and Adjustment – AFTER T.O.1F-4-860 (Sheet 2 of 6)



4C-2-8-(158-3)

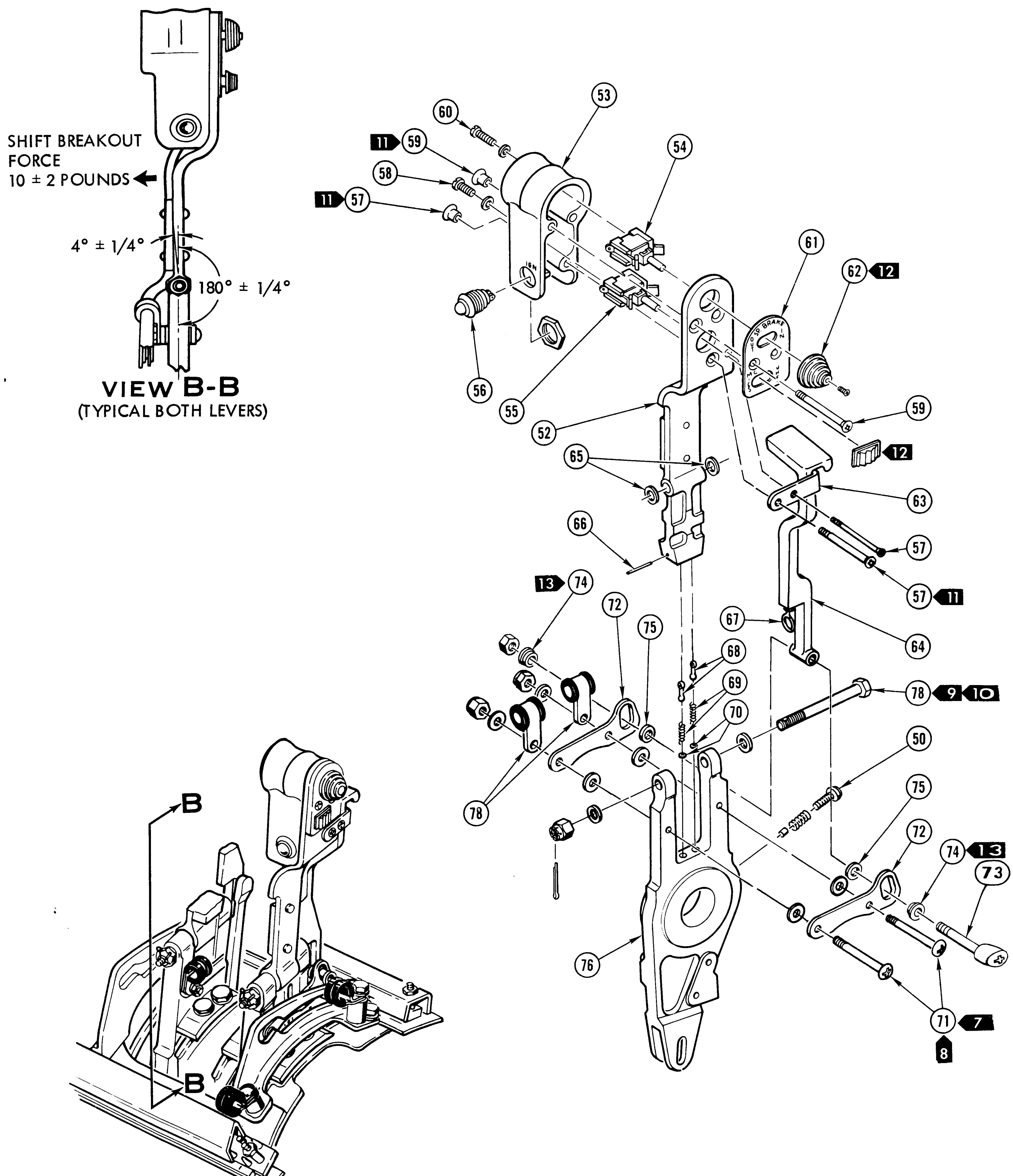
Figure 4-26. Forward Cockpit Throttle Quadrant Assembly and Adjustment - AFTER T.O.1F-4-860 (Sheet 3 of 6)



LEFT THROTTLE

4C-2-8-(158-4)A

Figure 4-26. Forward Cockpit Throttle Quadrant Assembly and Adjustment - AFTER T.O.1F-4-860 (Sheet 4 of 6)



RIGHT THROTTLE

4C-2-8-(158-5)A

Figure 4-26. Forward Cockpit Throttle Quadrant Assembly and Adjustment – AFTER T.O.1F-4-860 (Sheet 5 of 6)

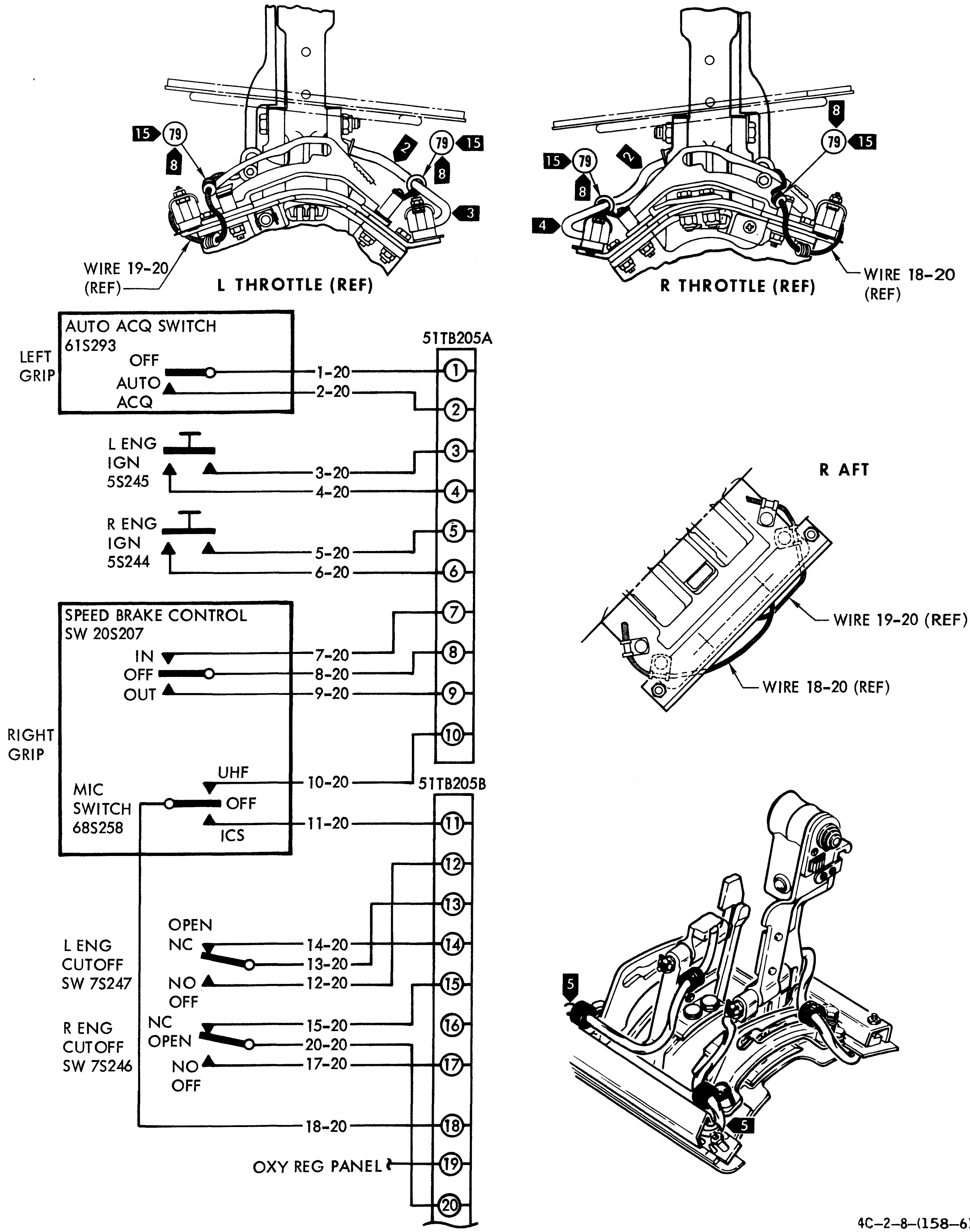


Figure 4-26. Forward Cockpit Throttle Quadrant Assembly and Adjustment – AFTER T.O.1F-4-860 (Sheet 6 of 6)

4-174. **Cleaning.**

a. Clean bolts (33 and 80), links (30 and 68) and shaft (25) in solvent.

4-175. **Inspection.**

a. Inspect shaft (25) for condition of dry film lubricant.

b. Inspect the lower lever bushing for evidence of galling. If bushing is galled, replace in accordance with the following procedures.

(1) Check lower lever for an individual friction adjustment screw. If this feature has been incorporated, remove adjustment screw, P/N AN503-8-10, remove nylon friction plug and remove heli-coil insert. Discard heli-coil insert and save adjustment screws and nylon friction plugs for reinstallation.

(2) Use an arbor press, to press out bushing, P/N AM43P20-016. Use a press base with at least a 1.5 inch diameter hole. The press or adapter tool shall be 1.430 $\pm$0.006 inches in diameter and at least 0.60 inches long. Lay the lower lever on press base with bushing centered over hole. Center the press adapter tool on bushing and apply sufficient force to push out bushing.

(3) Adjust the press base so that it is solid beneath lower lever. Place a new bushing on lower lever. Use same press adapter tool which was used to push old bushing out. Apply sufficient force to press new bushing into lower lever assembly until flush with surface of lower lever.

(4) Ream inside diameter of bushing to 1.250 +0.001, -0.000 inches in diameter using a hand reamer.

(5) If individual friction adjustment feature has been incorporated, drill a 0.173 $\pm$0.003 inch diameter hole through new bushing in line with existing tapped hole in lower lever assembly. Remove all burrs and break the sharp edge of drilled hole on inside diameter of bushing. Install new heli-coil, P/N MS2120900820. Reinstall nylon friction plug and adjustment screws.

c. Inspect washers (16 and 20), friction springs (15 and 21), for evidence of galling.

d. Inspect plates (7) for condition of dry film lubricant application on portion that contacts throttle lever.

4-176. **Repair.**

a. Replace all parts which fail to meet inspection requirements.

4-177. **Lubrication.**

CAUTION

Shaft (25) has dry film lubricant applied. Do not apply wet film lubricant to shaft or lower lever assembly bushings.

a. Lubricate bolts (27 and 80) with grease MIL-L-3572.

b. Lubricate links (30 and 68) with grease MIL-L-3572.

4-178. **Assembly of Right Throttle Lever.**

a. Connect wires to switch (56) and install switch in grip (53).

b. Attach finger lift (64) with guide (63) to arm (52) install screws (57) to guide.

c. Connect wires to switch (55) and install switch in grip (53).

d. Connect wires to switch (54) and install switch in grip (53).

e. *Secure retaining screws for switches (54 and 55) with lockwire.*

f. Install grip (53) to upper arm (52) and install plate (61), with screws (57 and 59). *Torque nuts for screws (57 and 59) 13 to 15 inch-pounds.*

g. Install button (62) to speed brake switch and button to microphone switch. Apply retaining compound to screw threads before installing screws.

h. Install links (68) to upper arm (52) with pin (66).

i. Install washers (70), as recorded in disassembly into arm (76) and install springs (69). Ten washers maximum.

j. Install lower arm (76) to upper arm (52) and insert bolt (80). Insure bolt passes through spring (67) of finger lift.

k. Install stop plates (72) with screws (71) and wire bundle clamp to forward and aft screws. *Torque nuts 20 to 25 inch pounds.* Add washers to outboard side of lever to obtain lever alignment of 180° $\pm$1/4° with lever shifted inboard. Add washer on inboard side of lever to obtain 4° $\pm$1/4° outboard shift angle, see view BB.

l. Tighten nut on bolt (80) until all parts are in contact. Back off nut until lever (76) shifts freely. Install cotter pin.

m. Install adjusting bolt (77) and position bolt eye in center of lever slot. Final adjustment to be made during throttle system rigging.

n. Install cap screw (73) with washers between stop plate (72) and finger lift (64) and a bushing (74) on the outside of each stop plate, 0.020 inch must be maintained.

4-179. **Assembly of Left Throttle Lever.**

a. Install switch (46) to arm (32) and connect wires to switch.

b. Install switch (48) to housing (47) and connect wires to switch.

c. Install housing (47) and lever knob (45) to arm (32).

d. Attach finger lift (42) with guide (41) to arm (32) install screws (40) in guide.

e. Install pin (31) and links (30) to arm (32).

f. Install washers (29), as recorded during disassembly, into lower arm (27) and install springs (28). Ten washers maximum.

g. Install upper arm (32) to lower arm (27) and insert bolt (33). Ensure bolt passes through spring of finger lift (43).

h. Install plates (34) with bolts, nuts and washers (51) and install wire bundle clamps on inboard side of forward

and aft screws. *Torque nuts 20 to 25 inch-pounds.* Add washers to outboard side of lever to obtain lever alignment of 180° ±1/4° with lever shifted inboard. Add washer on inboard side of lever to obtain 4° ±1/4° outboard shift angle.

i. Tighten nut (33) until all parts are in contact, then back off until lever (32) moves freely. *Install cotter pin.*

j. Install adjusting bolt (77) and position bolt eye in center of lever slot. Final adjustment to be made during throttle system rigging.

4-180. **Final Assembly.**

a. *Install shaft (25) into support (26) with key slot at top of shaft.* When a new undrilled shaft is being installed, locate shaft key slot in line with centerline of friction lever (while friction lever is positioned full aft). Drill bolt holes in shaft (25) and install bolt (24). See view A-A.

b. Install components on shaft (25) as follows:

(1) Install washer (23). Insert plug (50) in lever assembly. Install lever assembly (22) on shaft with ignition switch facing aft.

(2) *Install spring (21) with round (convex) side toward center of quadrant.*

(3) Install washer (20), key (18), cam (17), friction lever (19), key (18), cam (17), and washer (16).

(4) *Install spring (15) with round (convex) side toward center of quadrant.*

(5) Insert plug (50) in lever assembly (14). Install lever assembly (14) and washer (13). Ignition switch must face aft.

NOTE

Add washers (16 and 20), as required so components in this area are in contact with each other when friction lever is in low friction position. Force applied at throttle lever grip to move lever must not exceed 0.5 pounds.

c. Install support (12) on shaft and install bolt (11) with one washer under bolt head and two under nut.

d. Install bolts attaching cutoff switch support to quadrant support.

e. Install screw (50) in each throttle lever.

f. Install plates (8) and stop cam (4) to quadrant supports (12 and 26). *Torque nuts 20 to 25 inch-pounds.*

g. Install plates (6 and 7) to plate (8). Final adjustment to be made during airframe throttle system rigging.

h. Install cutoff switches (10) to support. Final adjustment to be made during airframe throttle system rigging.

i. Install terminal number strips (3) and terminal boards (2).

j. Connect wires to terminal strips and cutoff switches.

k. Install terminal board covers (1).

l. Install guards (9) on throttle cutoff switches (10).

4-181. **Testing.**

a. Throttle lever shift breakout force must be 10 pounds ±2 with throttle lever above IDLE position. Add washers (29 or 70) to lower arms as required with maximum number of ten washers.

b. Throttle lever must be aligned at 180° ±1/4° with throttle shifted inboard (see view B-B). Add washers to outboard side of lever to obtain lever alignment of 180° ±1/4° with lever shifted inboard as shown. Add washer on inboard side of lever to obtain 4° ±1/4° outboard shift angle.

c. *Force to move throttle levers, friction lever set at low friction, must not exceed 0.5 pounds when measured at center of throttle lever grip.*

d. With quadrant fully assembled and friction lever one third on, there should be an 0.020 inch normal gap between working edge of stop plate (7) and its mating surface on the throttle lever. If gap exceeds 0.035 inch, replace stop plate. If new stop plate does not give required gap replace lever arm.

e. Position and clamp wire bundles as shown.

f. Throttle movement checked from IDLE to OFF. Assure integrity of throttle lever electrical circuits have not been impaired.

4-182. **FORWARD COCKPIT THROTTLE QUADRANT BEFORE T.O.1F-4-860.** See figure 4-27.

4-183. **Tools and Equipment.**

Wrench, torque, 0 to 50 inch-pounds
Wrench, torque, 0 to 100 inch-pounds
Scale, spring

4-184. **Materials.**

Compound, retaining, MIL-S-22473, (grade C)
Grease, MIL-L-3572
Solvent, P-D-680
Lockwire, MS20995NC20
Pin, cotter, MS24665-136

4-185. **Disassembly.**

a. Remove two terminal covers (1).

b. Remove guard (9) from throttle cutoff switches (10) and disconnect wires from terminal boards and throttle cutoff switches.

c. Remove terminal boards (2) and terminal number decal strips (3).

d. Remove idle cutoff spring assembly (4) from plate assemblies (5 and 8).

e. Remove throttle cutoff switches (10) from switch support.

f. Remove bolts attaching throttle cutoff switch support to outboard quadrant support (12).

g. Remove plates (6 and 7) from plate assembly (8).

h. Remove plate assembly (8) from quadrant supports (12 and 26).

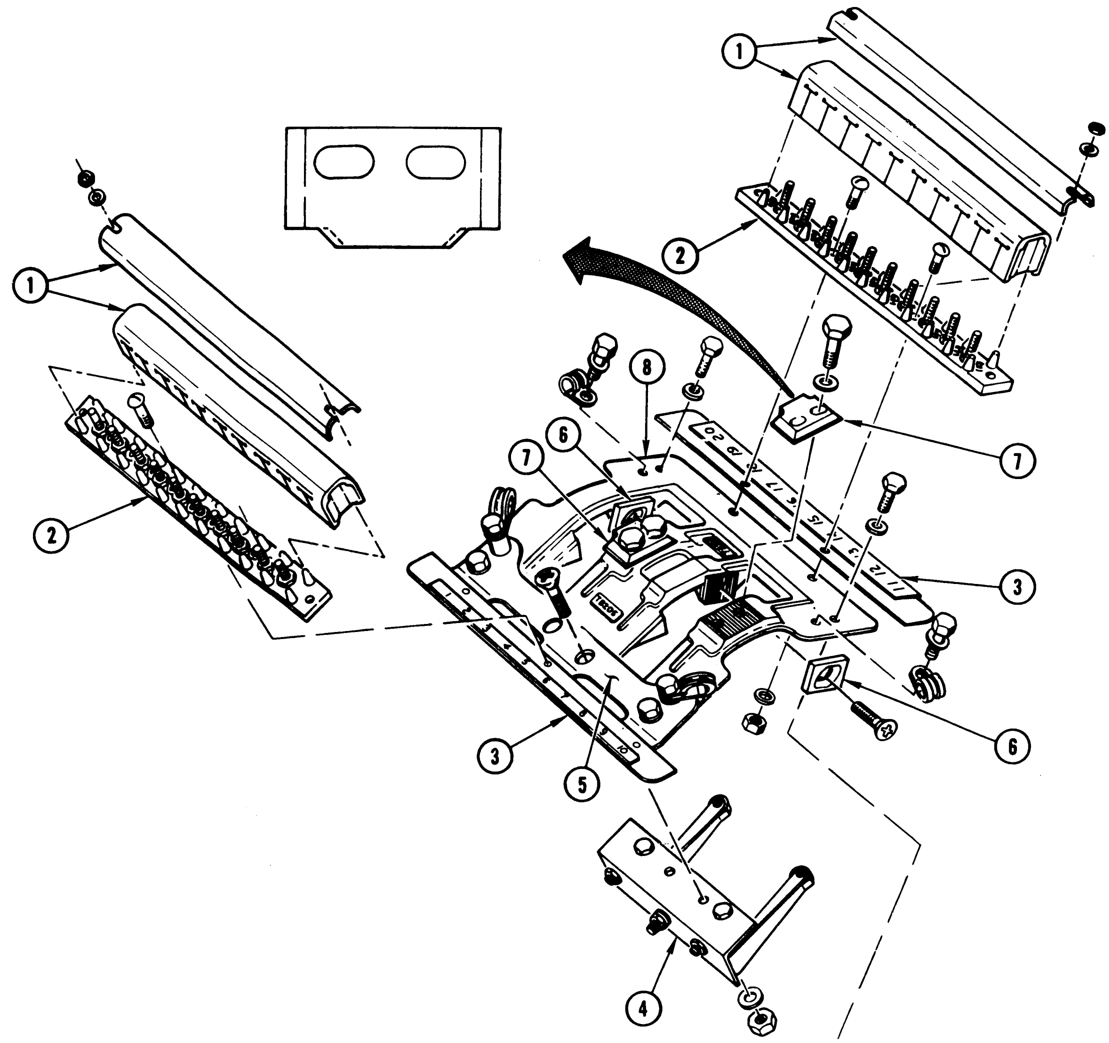
i. Remove lever friction adjustment screws (58) and plugs (59) from throttle levers (14 and 22).

j. Remove bolt (11) attaching outboard quadrant

1. TERMINAL BOARD COVER, NUT, WASHER	31. WASHERS
2. TERMINAL BOARD ASSY.	32. GRIP
3. NUMBER DECAL	33. SWITCH ASSEMBLY
4. IDLE CUTOFF SPRING ASSY.	34. HOUSING
5. QUADRANT PLATE ASSY.	35. LEFT ENGINE IGNITION SWITCH
6. ADJUSTABLE MILITARY STOP PLATES	36. SCREW, WASHERS, NUT
7. SHIFTED ADJUSTABLE IDLE AND MILITARY STOP PLATES	37. STOP PLATE
8. LEVER STOP PLATE	38. PIN
9. GUARD	39. LINKS
10. THROTTLE CUTOFF SWITCHES	40. BOLT, WASHERS, NUTS
11. BOLT, WASHERS, NUT	41. BOLT, WASHERS, NUT, COTTER PIN
12. QUADRANT OUTBOARD SUPPORT	42. UPPER ARM ASSY.
13. WASHER	43. LOWER LEVER ARM ASSEMBLY
14. LEFT ENGINE LEVER ASSY.	44. SPRINGS
15. FRICTION SPRING	45. WASHERS
16. WASHER	46. PIN
17. FRICTION ADJUSTMENT CAM	47. LINKS
18. CAM KEY	48. SWITCH KNOB
19. FRICTION LEVER	49. SWITCH KNOB, SCREW
20. WASHER	50. SCREWS, NUTS
21. FRICTION SPRING	51. INSTRUCTION PLATE
22. RIGHT ENGINE LEVER ASSY.	52. GRIP
23. WASHER	53. SPEED BRAKE CONTROL SWITCH
24. BOLT, WASHERS, NUT	54. UHF-ICS MICROPHONE SWITCH
25. SHAFT	55. RIGHT ENGINE IGNITION SWITCH
26. QUADRANT INBOARD SUPPORT	56. SCREW, WASHERS, NUT
27. BOLT, WASHERS, NUT, COTTER PIN	57. STOP PLATE
28. LOWER LEVER ARM ASSY.	58. SCREW, HELICOIL
29. UPPER ARM ASSY.	59. PLUG
30. SPRINGS	

4C-2-8-(156-1)

Figure 4-27. Forward Cockpit Throttle Quadrant Assembly and Adjustment – BEFORE T.O.1F-4-860 (Sheet 1 of 4)



NOTES

1 PROVIDE 4.50 ± 0.10 INCH WIRE BUNDLE LENGTH BETWEEN FACES OF CLAMPS.

2 WIRE BUNDLE NOT TO EXTEND BEYOND EDGE OF TERMINAL BOARD COVER.

3 WIRE BUNDLE NOT TO EXTEND 0.10 INCH MAXIMUM BEYOND EDGE OF TERMINAL BOARD COVER.

4 VINYL COVERING ON WIRE BUNDLE TO EXTEND BEYOND OUTER MOUNTING BOLTS.

5. POSITION WIRE TERMINALS WITHIN THE BARRIERS TO PROVIDE A MINIMUM CLEARANCE WITH BARRIER POSTS OF 0.03 INCH TO PROVIDE CLEARANCE FOR COVER INSTALLATION.

6 APPLY A LIGHT COAT OF MIL-L-3572 OR MIL-L-15719 TO BOLT AND THROTTLE ARMS.

7 DELETED

8 TIGHTEN NUT UNTIL ALL PARTS ARE IN CONTACT THEN BACK OFF UNTIL UPPER ARM MOVES FREELY.

9 APPLY RETAINING COMPOUND MIL-S-22473 CLASS C TO THREADS OF SCREW.

10 TORQUE NUT 20-25 IN. LBS.

11 SHIM STOPS FOR SHIFT THROW ANGLES, USE NAS1197-10L WASHERS.

12. ITEMS 6, 7, 10, 58, AND 59 ARE ADJUSTED DURING AIRFRAME POWER PLANT CONTROL SYSTEM RIGGING.

4C-2-8-(156-2)A

Figure 4-27. Forward Cockpit Throttle Quadrant Assembly and Adjustment – BEFORE T.O.1F-4-860 (Sheet 2 of 4)

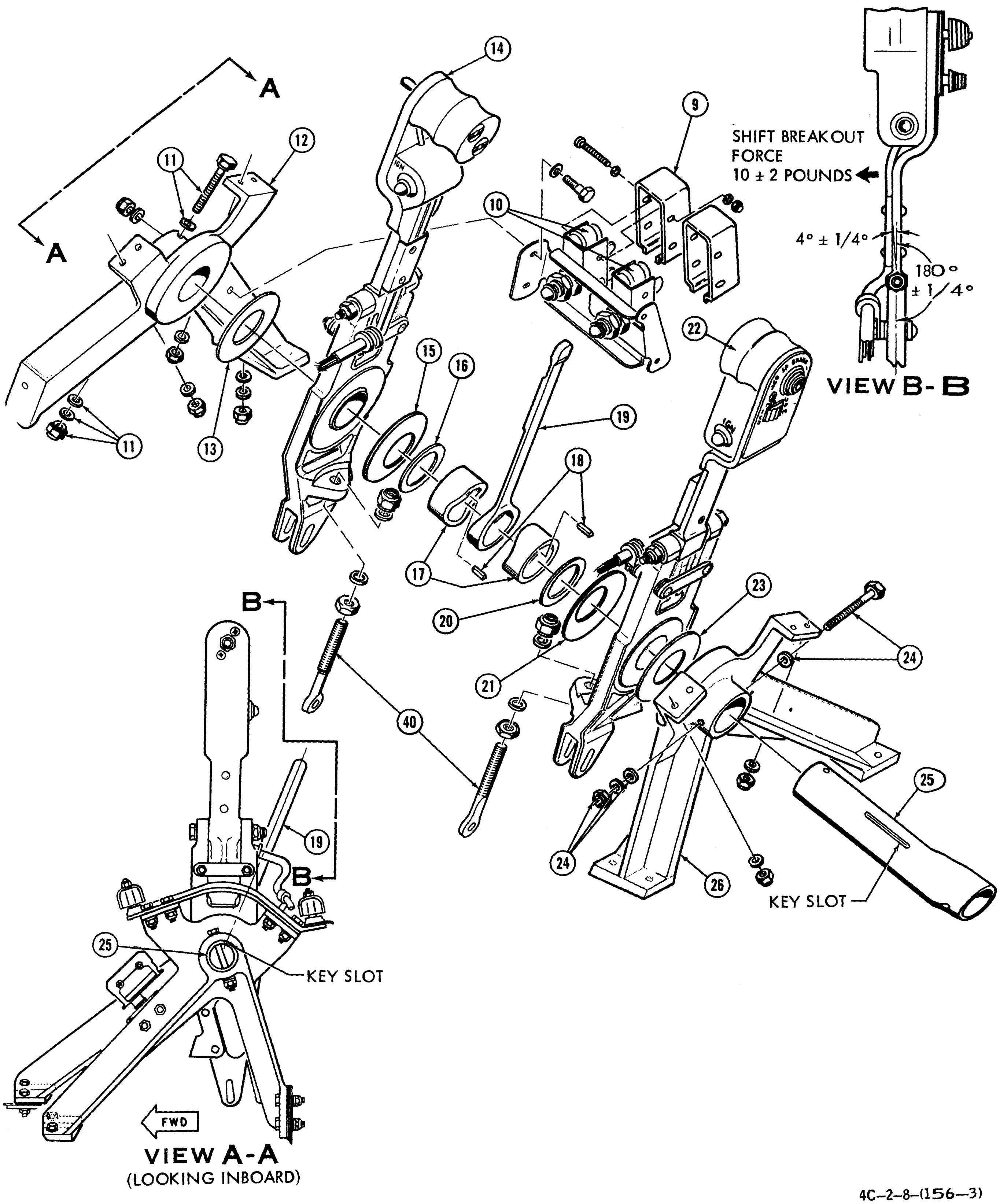


Figure 4-27. Forward Cockpit Throttle Quadrant Assembly and Adjustment – BEFORE T.O.1F-4-860 (Sheet 3 of 4)

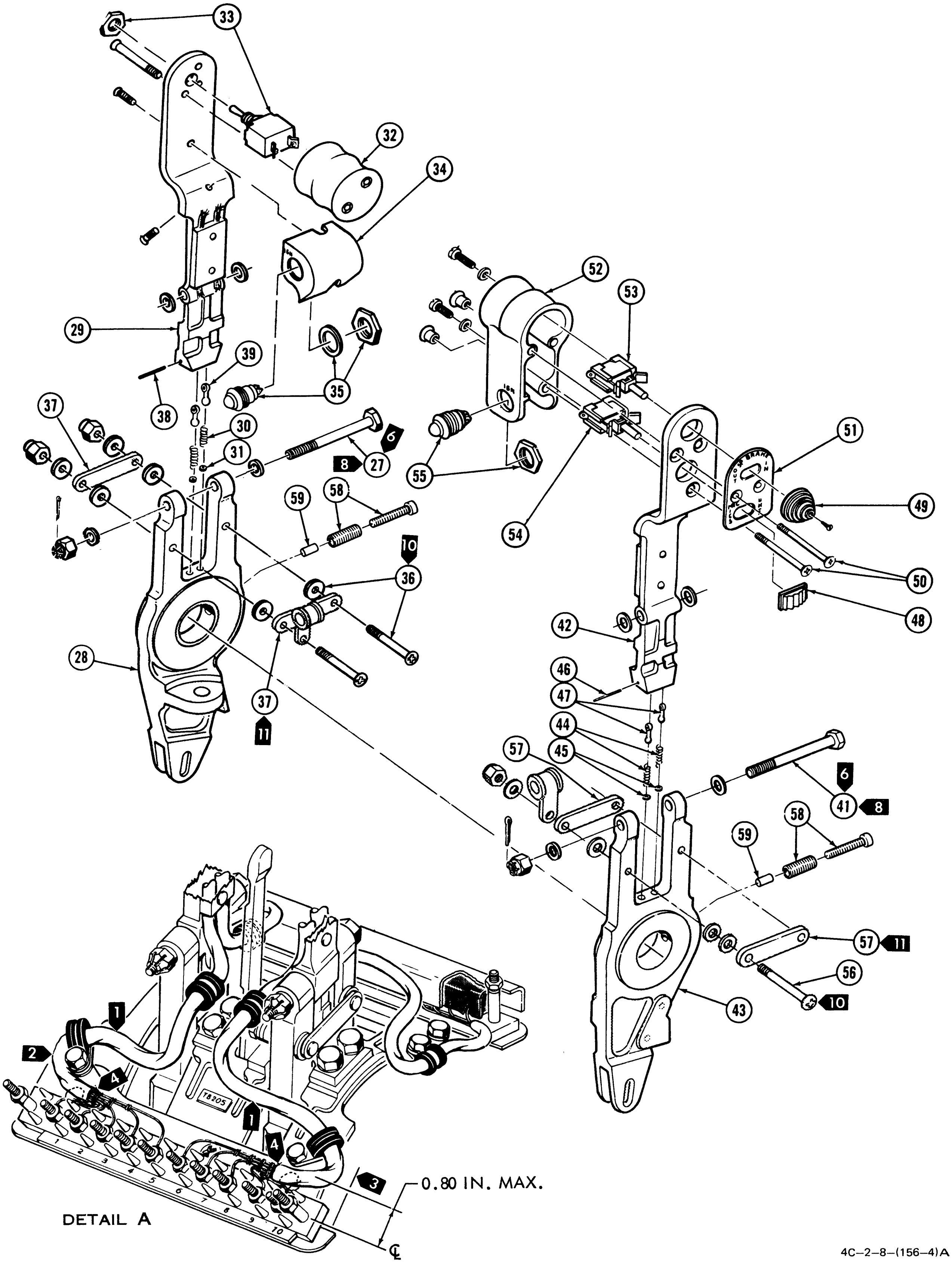


Figure 4-27. Forward Cockpit Throttle Quadrant Assembly and Adjustment – BEFORE T.O.1F-4-860 (Sheet 4 of 4)

support (12) to shaft (25) and remove quadrant support.

k. Remove items (13 thru 16) in sequence. Remove cam (17), key (18), friction lever (19), cam (17), and key (18). Remove items (20 thru 25) in sequence.

4-186. **Disassembly of Left Lever Assembly.**

a. Remove screws (36), plates (37), and wire bundle clamp.

b. Remove bolt (27) and separate upper arm (29) from lower arm (28). Retain springs (30) and washers (31). Record number of washers for assembly.

c. Remove screws attaching grip (32) to arm (29).

d. Disconnect wires from switch (33) and remove switch from arm (29).

e. Remove ignition switch housing (34) and disconnect wires from switch (35). Remove switch.

f. Remove pin (38) and remove links (39) from arm (29).

g. Remove adjustment bolt (40) from arm (28).

4-187. **Disassembly of Right Lever Assembly.**

a. Remove screws (56), plates (57), and wire bundle clamp from lever assembly (22).

b. Remove bolt (41) and separate upper throttle arm (42) from lower arm (43). Retain springs (44) and washers (45). Record number of washers for assembly.

c. Remove switch buttons (48 and 49).

d. Remove screws (50), plate (51), and lever grip (52) from arm (42).

e. Remove switches (53 and 54) from lever grip (52). Disconnect wires from speed brake switch (53) and microphone switch (54).

f. Disconnect wires from ignition switch (55) and remove switch from grip (52).

g. Remove adjustment bolt (40) from lower arm (43).

4-188. **Cleaning.**

a. Clean bolts (27 and 41), links (39 and 47), and shaft (25) in solvent.

4-189. **Inspection.**

a. Inspect shaft (25) for condition of dry film lubricant.

b. Inspect the lower lever bushing for evidence of galling. If bushing is galled, replace in accordance with the following procedures.

(1) Check lower lever for an individual friction adjustment screw.

If this feature has been incorporated, remove adjustment screw, P/N AN503-8-10, remove nylon friction plug and remove heli-coil insert. Discard heli-coil insert and save adjustment screws and nylon friction plugs for reinstallation.

(2) Use an arbor press, to press out bushing, P/N AM43P20-016. Use a press base with at least a 1.5 inch diamter hole. The press or adapter tool shall be 1.430 $\pm$0.006 inches in diameter and at least 0.60 inches long. Lay the lower lever on press base with bushing centered over hole. Center the press adapter tool on bushing and apply sufficient force to push out bushing.

(3) Adjust the press base so that it is solid beneath lower lever. Place a new bushing on lower lever. Use same press adapter tool which was used to push old bushing out. Apply sufficient force to press new bushing into lower lever assembly until flush with surface of lower lever.

(4) Ream inside diameter of bushing to 1.250 +0.001, −0.000 inches in diameter using a hand reamer.

(5) If individual friction adjustment feature has been incorporated, drill a 0.173 $\pm$0.003 inch diameter hole through new bushing in line with existing tapped hole in lower lever assembly. Remove all burrs and break the sharp edge of drilled hole on inside diameter of bushing. Install new heli-coil, P/N MS2120900820. Reinstall nylon friction plug and adjustment screws.

c. Inspect washers (16 and 20), friction springs (15 and 21), for evidence of galling.

d. Inspect plates (7) for condition of dry film lubricant application on portion that contacts throttle lever.

4-190. **Repair.**

a. Replace all parts which fail to meet inspection requirements.

4-191. **Lubrication.**

CAUTION

Shaft (25) has dry film lubricant applied. Do not apply wet film lubricant to shaft or lower lever assembly bushings.

a. Lubricate bolts (27 and 41) with grease MIL-L-3572.

b. Lubricate links (39 and 47) with grease MIL-L-3572.

4-192. **Assembly of Right Throttle Lever.**

a. Assemble right throttle lever assembly as follows:

(1) Connect wires to ignition switch (55) and install switch in grip (52).

(2) Connect wires to switch (53) and install switch in grip (52).

(3) Connect wires to switch (54) and install switch in grip (52).

(4) *Secure retaining screws for switches (53 and 54) with lockwire.*

(5) Install grip (52) to arm (42) and install plate (51) with screws (50). *Torque nuts for screws (50) 13 to 15 inch-pounds.*

(6) Install button (49) to speed brake switch and button (48) to microphone switch. Apply retaining compound to screw threads before installing screws.

(7) Install links (47) to arm (42) with pin (46).

(8) Install washers (45), as recorded in disassembly into arm (43) and install springs (44). Ten washers maximum.

(9) Install lower arm (43) to upper arm (42) and insert bolt (41).

(10) Install plates (57) with bolts (56) and wire bundle

clamps to aft bolt. *Torque nuts 20 to 25 inch-pounds. Add washers to outboard side of lever to obtain lever alignment of 180° $\pm$1/4° with lever shifted inboard as shown.* Add washer on inboard side of lever to obtain 4 $\pm$1/4° outboard shift angle, see view B–B.

(11) Tighten nut on bolt (41) until all parts are in contact. Back off nut until lever (42) shifts freely. *Install cotter pin.*

(12) Install adjusting bolt (40) and position bolt eye in center of lever slot. Final adjustment to be made during throttle system rigging.

4–193. **Assembly of Left Throttle Lever.**

a. Install switch (33) to arm (29) and connect wires to switch.

b. Install switch (35) to housing (34) and connect wires to switch.

c. Install housing (34) and lever grip (32) to arm (29).

d. Install pin (38) and links (39) to arm (29).

e. Install washers (31), as recorded during disassembly, into arm (28) and install springs (30). Ten washers maximum.

f. Install upper arm (29) to lower arm (28) and insert bolt (27).

g. Install plates (37) with screws (36) and install wire bundle clamp on inboard side of aft bolt. *Torque nuts 20 to 25 inch-pounds.* Add washers to outboard side of lever to obtain lever alignment of 180° $\pm$1/4° with lever shifted inboard as shown. Add washer on inboard side of lever to obtain 4° $\pm$1/4° outboard shift angle.

h. Tighten nut on bolt (27) until all parts are in contact, then back off until lever (29) moves freely. *Install cotter pin.*

i. Install adjusting bolt (40) and position bolt eye in center of lever slot. Final adjustment to be made during throttle system rigging.

4–194. **Final Assembly.**

a. Install shaft (25) into support (26) with key slot at top of shaft. When a new undrilled shaft is being installed, locate shaft key slot in line with centerline of friction lever (while friction lever is positioned full aft). Drill bolt holes in shaft (25) and install bolt (24). See view A–A.

b. Install components on shaft (25) as follows:

(1) Install washer (23). Insert plug (59) in lever assembly. Install lever assembly on shaft with ignition switch facing aft.

(2) *Install spring (21) with round (convex) side toward center of quadrant.*

(3) Install washer (20), key (18), cam (17), friction lever (19), key (18), cam (17), and washer (16).

(4) *Install spring (15) with round (convex) side toward center of quadrant.*

(5) Insert plug (59) in lever assembly. Install lever assembly and washer (13). Ignition switch must face aft.

NOTE

Add washers (16 and 20), as required so components in this area are in contact with each other when friction lever is in low friction position. Force applied at throttle lever grip to move lever must not exceed 0.5 pounds.

c. Install support (12) on shaft and install bolt (11) with one washer under bolt head and two under nut.

d. Install bolts attaching cutoff switch support to quadrant support.

e. Install screw (58) in each throttle lever.

f. Install plates (8 and 4) to quadrant supports (12 and 26). *Torque nuts 20 to 25 inch-pounds.*

g. Install plates (6 and 7) to plate (8). Final adjustment to be made during airframe throttle system rigging.

h. Install cutoff switches (10) to support. Final adjustment to be made during airframe throttle system rigging.

i. Install idle cutoff spring assembly (4) to plates (5 and 8). *With lever at IDLE, adjust stops to obtain 0.01 $\pm$0.01 inches clearance between roller and lever.*

j. Install terminal number decal strips (3) and terminal boards (2).

k. Connect wires to terminal strips and throttle cutoff switches.

l. Install terminal board covers (1).

m. Install covers (9) on throttle cutoff switches (10).

4–195. **Testing.**

a. Throttle lever shift breakout force must be 10 pounds $\pm$2 with throttle lever above IDLE position. Add washers (31 or 45) to lower arms as required with maximum number of ten washers.

b. Throttle lever must be aligned at 180° $\pm$1/4° with throttle shifted inboard (see view B–B). Add washers to outboard side of lever to obtain lever alignment of 180° $\pm$1/4° with lever shifted inboard as shown. Add washers on inboard side of lever to obtain 4° $\pm$1/4° outboard shift angle.

c. *Force to move throttle levers, friction lever set at low friction, must not exceed 0.5 pounds when measured at center of throttle lever grip.*

d. Idle cutoff spring assembly roller to throttle lever clearance must be 0.01 $\pm$0.01 inches with throttle lever at IDLE.

e. *With quadrant fully assembled and friction lever one third on, there should be an 0.020 inch normal gap between working edge of stop plate (7) and its mating surface on the throttle lever. If gap exceeds 0.035 inch, replace stop plate. If new stop plate does not give required gap replace lever arm.*

f. Position and clamp wire bundles as shown (see detail A).

g. Assure integrity of throttle lever electrical circuits have not been impaired.

SECTION V

MAIN FUEL SYSTEM

DESCRIPTION

5-1. **SYSTEM DESCRIPTION.** See figure 5-1.

5-2. The main fuel system regulates the flow of fuel that is sprayed into the combustion section of the engine. When the fuel air mixture is ignited, sufficient energy is produced to drive the compressor and expel the burned gases through the exhaust nozzle. The engine speed, which is developed from the extraction of energy by the turbine is controlled by the main fuel control.

5-3. **COMPONENT DESCRIPTION.**

5-4. The components of the main fuel system are as follows:

a. Main fuel pump and low pressure filter.

b. Bypass indicator switch.

c. Main fuel filter.

d. Main fuel control.

e. Compressor inlet temperature sensor (CIT).

f. Pressurizing and drain valve.

g. Fuel nozzles.

5-5. **MAIN FUEL PUMP AND LOW PRESSURE FILTER.** The main fuel pump filters and delivers fuel at a high pressure to the main fuel control. The main fuel pump consists of a boost impeller, low pressure filter, main pumping element, and pressure relief valve. The pump is on the rear face of the transfer gearbox on the right end.

5-6. **BYPASS INDICATOR SWITCH.** The bypass indicator switch completes an electrical circuit to provide cockpit indication when the low pressure filter element is about to be bypassed.

5-7. **MAIN FUEL FILTER.** The main fuel filter prevents contamination from being carried into the main fuel control by the fuel. The main fuel filter houses a relieving type 40 micron main element. In addition, the filter includes a relieving type 10 micron servo element.

Table 5-1. Leading Particulars.

Leading Particulars	Specifications
MAIN FUEL PUMP	
Rotation	CCW when viewed from the drive end
Shaft failure	3000 to 3500 inch-pounds for main element 700 to 1000 inch-pounds for boost element
Pressure relief	Bypasses fuel internally to prevent main element pressure rise from exceeding 1125 psi;
Power extraction	60 hp (maximum)
High pressure capacity	60 gpm (minimum) with 3800 RPM pump speed, -7.5 psi inlet pressure, and 1000 psi discharge pressure
Low pressure capacity	72.3 gpm (maximum) with pump speed 3800 RPM, 50 psi inlet pressure, and 185 psi discharge pressure
Low speed capacity	6 gpm (minimum) with 500 RPM pump speed, -7.5 psi inlet pressure, and 100 psi discharge pressure
Rated speed	3800 RPM
Filtration	40 micron
Filter bypass	33 ±3 psi
Boost pressure rise	29 to 70 psi

CONTINUED

Table 5–1. Leading Particulars.

Leading Particulars	Specifications
MAIN FUEL FILTER	
Rated flow	Main element 68 gpm Servo element 6.7 gpm
Filtration	Main element 40 micron Servo element 10 micron
Pressure drop (clean filter)	Main element 30 psi (maximum) Servo element 20 psi (maximum)
Pressure drop (clogged filter)	Main element 50 psi (maximum) Servo element 60 psi (maximum)
Bypass valve	Main element 25 psi Servo element 25 psi
MAIN FUEL CONTROL	
Operating fluid	MIL–T–5624, grade JP–4, with an average specific gravity of 0.76 at 60°F
Lubrication	No external lubrication required
Rated speed	3815 rpm
Rotation (drive shaft)	CCW when viewed from the drive end
Torque limits (drive shaft)	Shear section designed to fail at torque load of 300 to 1000 inch–pounds.
Shutdown valve leakage	With throttle shaft in the zero degree position, maximum leakage in either direction of 300 cc per minute
Overboard leakage	1 cc per minute (maximum)
Afterburner on–off signal	500 to 600 pph at discharge pressure of 130 psi or above. Pressure not to exceed 20 psi above case pressure when no signal is desired
Fuel flow for variable vane positioning	5500 pph (maximum), of which 150 pph is cooling flow
Spring load, variable vane feedback	4 to 20 inch–pounds.
Main fuel control discharge pressure	70 to 970 psi
Control case pressure	15 to 125 psi
Fuel inlet pressure	125 to 1000 psi

CONTINUED

Table 5-1. Leading Particulars.

Leading Particulars	Specifications
Throttle range (angular)	0–4.5 degrees engine off; 4.5 to 10 degrees transistion from off to idle speed; 10 to 13 degrees idle speed (65 $\pm$1.0 percent); 13 to 71 degrees transition from idle to top speed (100 $\pm$0.5 percent); 71 to 75 degrees military; 75 to 78 degrees transition from military to minimum afterburning; 78 to 110 degrees transition from minimum to maximum afterburning; 110 to 113 degrees maximum afterburning.
PRESSURIZING AND DRAIN VALVE	
Pressure limitations	Functions normally at 0 to 1000 psi internal pressure
Pressure drop	30 psid (maximum) at a flow of 18,500 pph, reference pressure of 30 psig, and 750 psig manifold pressure
Reference pressure range	40 to 90 psi
Leakage (external)	None
Leakage (drain port)	5 cc per minute (maximum)
Leakage (reference port to drain on shutdown)	50 cc per minute (maximum)
Time from fuel shut off to drain	3 seconds (maximum)

5-8. **MAIN FUEL CONTROL.** The main fuel control governs engine speed by controlling fuel flow. A governor in the control establishes and maintains selected engine speed except during certain engine conditions which require the speed to be rescheduled. The control limits fuel flow variations to ensure fast, stall free accelerations and decelerations. During the throttle bursts, the control postpones initiation of afterburner operation to achieve the fastest possible acceleration. The control also positions the variable vanes to preserve compressor performance under varying operating conditions.

5-9. The main fuel control combines the inputs of throttle position, compressor discharge pressure, compressor inlet temperature, and engine speed to produce the fuel flow to operate the engine. Throttle movement is transmitted to the control through rotation of the power shaft by the aircraft throttle linkage assisted by the torque booster. Compressor discharge air pressure is piped into a sensing bellows within the fuel control. Compressor inlet temperature is sensed by a separate unit that produces a mechanical signal representing air temperature. A shaft extending from the mounting flange of the control splines into a gear in the rear gearbox to provide the engine speed input. The control also receives a feedback signal representing variable vane position.

5-10. The control is mounted at the 6 o'clock position on the front of the rear gearbox. The control meters fuel for combustion and in addition provides the following:

a. A positive shutoff of engine fuel flow when the throttle is OFF.

b. A minimum fuel flow limit that allows the throttle to be safety retarded at high altitudes, and also provides a minimum starting fuel flow.

c. Acceleration and deceleration fuel schedules that permit unlimited throttle manipulation without causing compressor stall, combustion blowout, or excessive engine speed instability.

d. An increase in engine idle speed (up to 100 percent) during conditions of high compressor inlet air temperature.

e. A reduction in maximum engine speed during low compressor inlet air temperature.

f. A reduction in fuel flow at high compressor discharge pressures.

g. A control of the variable vanes as a function of engine speed and compressor inlet air temperature.

h. An afterburner on off pressure signal scheduled by throttle position and engine speed.

i. Regulated servo supply to the nozzle area control.

j. High pressure servo supply to the torque booster.

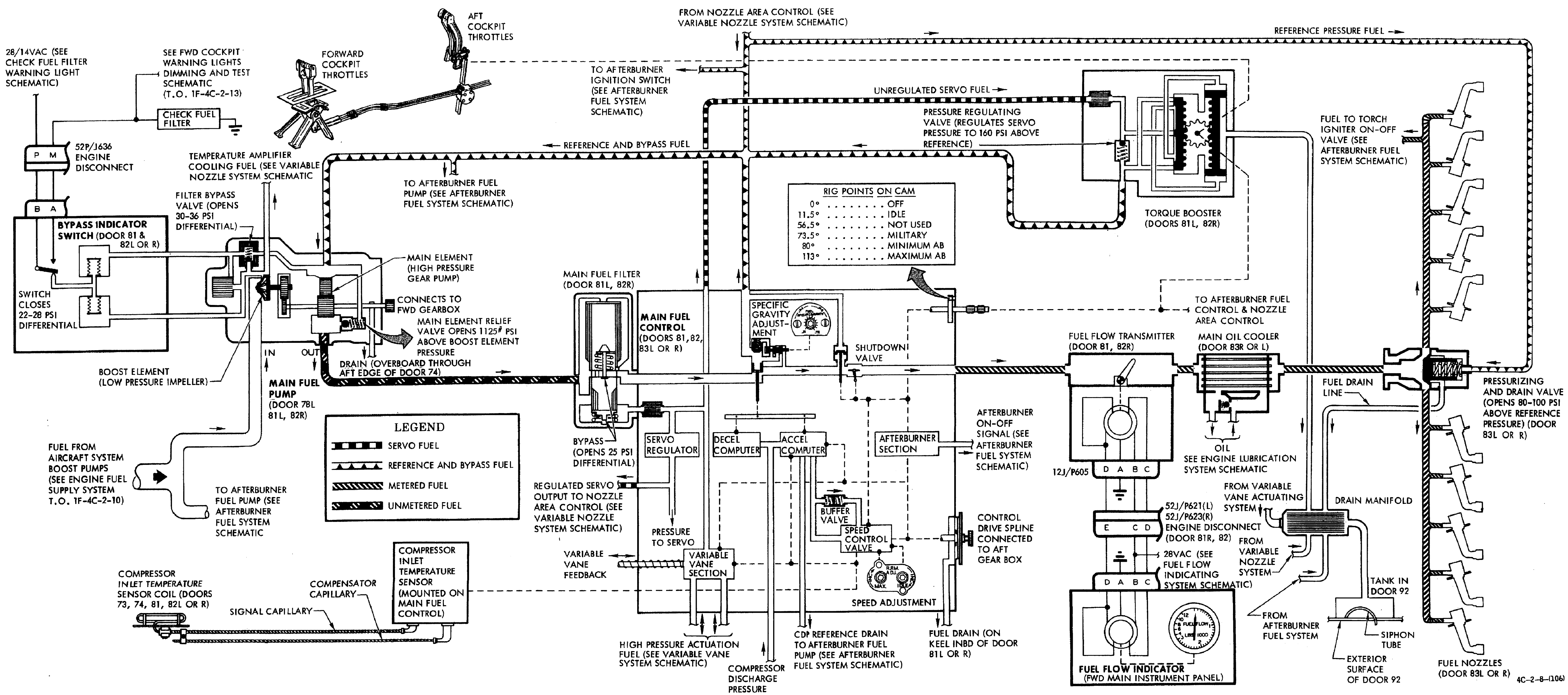


Figure 5-1. Main Fuel System Schematic

5-11. **COMPRESSOR INLET TEMPERATURE SENSOR.** The CIT sensor converts compressor inlet air temperature variations into a mechanical signal, which the main fuel control uses in establishing variable vane and acceleration fuel flow schedules, and in providing CIT resets of engine speed.

5-12. The sensor is a one piece, individually calibrated component. It consists of the sensor body, which is attached to the main fuel control; the sensing coil, which extends into the airstream in the compressor front frame; and two capillary tubes.

5-13. **PRESSURIZING AND DRAIN VALVE.** The pressurizing and drain valve prevents flow to the fuel nozzles until sufficient pressure is attained in the main fuel control to operate the servo assemblies, which are used to compute the fuel flow schedules. It also drains the fuel manifold at engine shutdown, but keeps the upstream portion of the system primed to permit fast starts. The pressurizing and drain valve is a pressure operated valve.

5-14. **FUEL NOZZLES.** The fuel nozzles introduce fuel into the combustion liners in a uniformly distributed spray pattern. Each fuel nozzle has two concentric spin chambers, a filter screen, and a flow divider valve. The nozzles are located in the compressor rear frame, one nozzle extending into the forward end of each of the 10 combustion liners.

TOOLS AND TEST EQUIPMENT

5-15. GENERAL.

5-16. To perform maintenance on the system or components, the special tools and test equipment listed in table 5-2 should be used. Alternate equipment with equal or greater range and accuracy than that in the Alternate Equipment column may be substituted. The listed tools and test equipment are for performing aircraft and shop maintenance procedures in this section of the manual.

Table 5-2. Tools and Test Equipment.

Name	Identification No.	Alternate Equip. Range	Alternate Equip. Accuracy	Use
Wrench, torque		0 to 150 inch-pounds		Main fuel control replacement
Wrench, torque		100 to 750 inch-pounds		
Clamp, fuel nozzle positioning	1C2769			Fuel nozzle replacement

AIRCRAFT MAINTENANCE.

5-17. REMOVAL AND INSTALLATION.

5-18. **MAIN FUEL CONTROL.** See figure 5-2.

5-19. **Tools and Equipment.**

Wrench, torque, 0 to 150 inch-pounds
Wrench, torque, 100 to 750 inch-pounds

5-20. **Manpower Requirement.**

a. Two men required.

5-21. **Materials.**

Lubricant, Plastilube Moly No. 3
Solvent, P-D-680
Lockwire, MS20995NC32

5-22. **Removal.**

a. Open doors 81 L or R, 82 L or R, 83 L or R and remove dropout link.

b. Remove torque booster from main fuel control.

c. Remove throttle input flexible cable.

d. Disconnect throttle input linkage conduits from nozzle area control, afterburner fuel control, and main fuel control cable boxes.

CAUTION

Variable vane feedback shaft in main fuel control is spring loaded. Do not release cable until spring tension is relieved or damage could result.

e. Remove variable vane feedback flexible cable.

f. Remove feedback conduit from bellcrank bracket and micro adjust unit on cable box.

CAUTION

Do not kink or bend capillary tubes.

g. Remove compressor inlet temperature sensor from main fuel control.

h. Disconnect fuel inlet line from main fuel filter. Remove fuel filter from main fuel control.

i. Disconnect variable vane actuation pressure hoses at manifolds.

j. Disconnect at control:

(1) CDP reference, AB initiation, and servo fuel hoses.

(2) CDP air line.

LEGEND

1. ROD-END HOSE (TO/FROM VANE ACTUATORS). TORQUE 150-250 LB-IN.*
2. 90° ELBOW, JAM NUT AND O-RING. TORQUE JAM NUT 360-400 LB-IN.*
3. HEAD-END HOSE (TO/FROM VANE ACTUATORS). TORQUE 150-250 LB-IN.*
4. REDUCER AND O-RING. TORQUE 360-400 LB-IN.
5. SERVO SUPPLY HOSE (TO TORQUE BOOSTER). TORQUE 135-150 LB-IN.*
6. REDUCER AND O-RING. TORQUE 180-200 LB-IN.*
7. BOLT AND WASHER. TORQUE 24-27 LB-IN.*
8. UNION AND O-RING. TORQUE 135-150 LB-IN.
9. CDP TUBE (FROM COMPRESSOR REAR FRAME). TORQUE 135-150 LB-IN.
10. SIGNAL TUBE (TO AB FUEL PUMP). TORQUE 270-300 LB-IN.
11. UNION AND O-RING. TORQUE 180-200 LB-IN.
12. LOCKNUT AND TABWASHER. TORQUE 30-40 LB-IN.
13. THROTTLE CABLE BOX AND DIAL.
14. REFERENCE TUBE (TO AB FUEL PUMP). TORQUE 135-150 LB-IN.*
15. V-BAND CLAMP AND GASKET. TORQUE 80-90 LB-IN.*
16. 90° ELBOW, JAM NUT AND O-RING. TORQUE JAM NUT 135-150 LB-IN.*
17. DRAIN TUBE — QEC KIT.
18. BYPASS TUBE AND SEAL (TO MAIN FUEL PUMP)
19. BOLT AND WASHER (QTY-8). TORQUE 55-70 LB-IN.*
20. OUTLET HOSE AND SEAL (TO FLOWMETER - QEC KIT)
21. UNIVERSAL CONNECTOR, BOLT AND 2 O-RINGS. TORQUE 110-125 LB-IN.*
22. SERVO TUBE (TO NAC). TORQUE 135-150 LB-IN.*
23. MICRO-ADJUST (TO CABLE BOX). TORQUE 50-60 LB-IN.* MICRO-ADJUST (TO CONDUIT). TORQUE 60-80 LB-IN.*
24. LOCKNUT AND TABWASHER. TORQUE 30-40 LB-IN.
25. BOLT AND WASHER (QTY-3). TORQUE 24-27 LB-IN.*
26. VARIABLE VANE CABLE BOX AND OVERTRAVEL TUBE. TORQUE 10-20 LB-IN.*

* LOCKWIRE REQUIRED

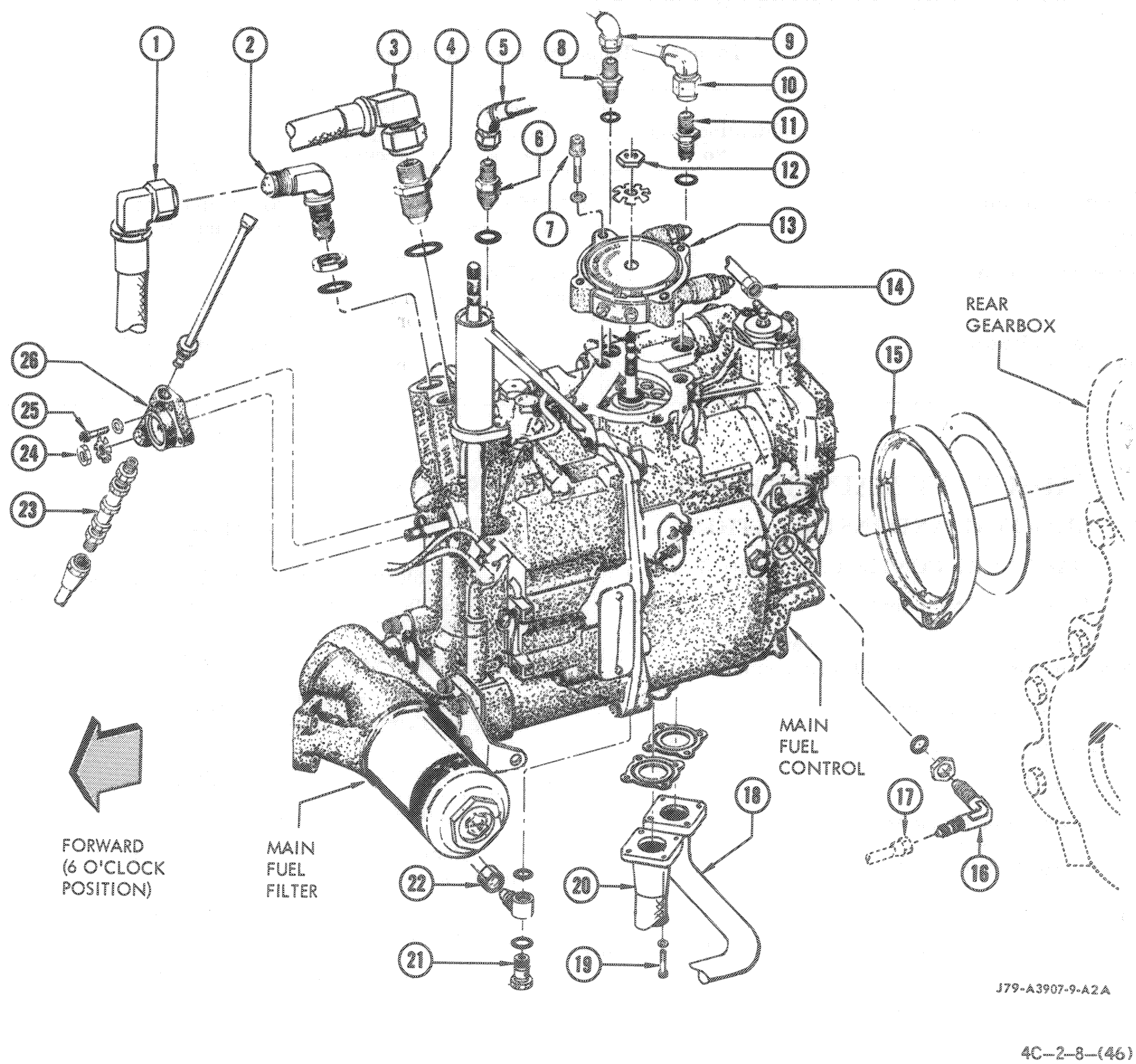


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Figure 5-2. Main Fuel Control Removal and Installation

i. Disconnect fuel inlet line from main fuel filter. Remove fuel filter from main fuel control.

j. Disconnect variable vane actuation pressure hoses at manifolds.

k. Disconnect at control:

(1) CDP reference, AB initiation, and servo fuel hoses.

(2) CDP air line.

(3) Overboard drain and regulated servo fuel hoses.

(4) Bypass fuel hose.

(5) Metered fuel hose.

NOTE

Main fuel control weighs approximately 45 pounds.

l. Remove fuel control mounting clamp and slide control forward to disengage spline shaft.

CAUTION

Leave cable boxes on control if excessive force is needed to remove them. Control will be damaged if boxes are forced off shafts.

m. Remove cable boxes and hose fittings from control.

5-23. Installation.

a. *Install align, and torque hose fittings to control.*

b. Install throttle input cable box. Check date on control box prior to installing. If three years old, change control box. ***Torque bolts 24 to 27 inch—pounds and lockwire.*** **Install pointer, lockwasher, and locknut on shaft. Do not tighten.**

c. Install variable vane feedback cable box and micro adjust unit. *Torque bolts 24 to 27 inch-pounds and lockwire.* Install shaft, lockwasher, and locknut. Do not tighten.

d. Install throttle crossover shaft to the control.

e. Clean control drive shaft spline with a wire brush and solvent to remove dirt, grit, and old lubricant; relubricate spline.

f. Install new gasket and mount control on rear gearbox mounting pad. Align dowel pin on base of control with holes in gasket and mounting flange. *Torque clamp 80 to 90 inch-pounds and lockwire.*

g. Mount compressor inlet temperature sensor on main fuel control. *Torque bolts to main fuel control clamps 20 to 30 inch-pounds and lockwire.*

h. Connect and torque.

(1) *Metered fuel hose.*

(2) *Bypass fuel hose.*

(3) *Overboard drain and regulated servo fuel hoses.*

(4) *CDP air line.*

(5) *CDP reference, AB initiation, and servo fuel hoses.*

i. Install variable vane actuation pressure hoses.

j. Install fuel filter and fuel inlet line.

k. Install variable vane feedback linkage conduit and bracket. *Torque 60 to 80 inch-pounds and lockwire.*

l. Install variable vane feedback cable and rig.

m. Install throttle input linkage conduits. *Torque 60 to 80 inch-pounds and lockwire.*

n. *Install throttle input linkage flexible cable and rig.*

o. Install torque booster and bracket to throttle input shaft.

p. Install dropout link.

NOTE

After replacement of main fuel control, placard respective fuel flow indicator on forward cockpit instrument panel to identify model of fuel control installed.

q. *Close doors 22, 81L or R, 82L or R and 83L or R.*

r. *Perform engine start and check for evidence of leakage.*

s. *Perform a manual throttle system rigging check, engine operating. Refer to section IV.*

5-24. **MAIN FUEL PUMP.** See figure 5-3.

5-25. **Materials.**

Lockwire, MS20995NC32
Solvent, P-D-680, Type II
Lubricant, Plastilube Moly No. 3

5-26. **Removal.**

WARNING

To prevent injury to personnel, make sure safety struts are installed on door 81L and R actuators.

a. Gain access through doors 81L or R and open doors 22, 73L or R, 74L or R, 80 or 78 and 140.

(1) Visually make sure engine fuel shutoff valve indicator in door 22 reads closed. If valve indicator reads open, perform steps f thru k or paragraph 13-43.

b. Drain fuel from engine fuel manifold prior to disconnecting any fuel lines from main fuel pump.

c. Remove all brackets and clamps used to attach CSD supply and return lines.

d. Disconnect electrical lead to tachometer generator and remove clamps from pump.

e. Remove tachometer generator.

f. Remove starter assembly.

g. Remove seal drain line to fuel pump.

h. Disconnect amplifier cooling flow line from union on fuel pump.

i. Disconnect two fuel lines for bypass indicator switch from unions or fuel pump.

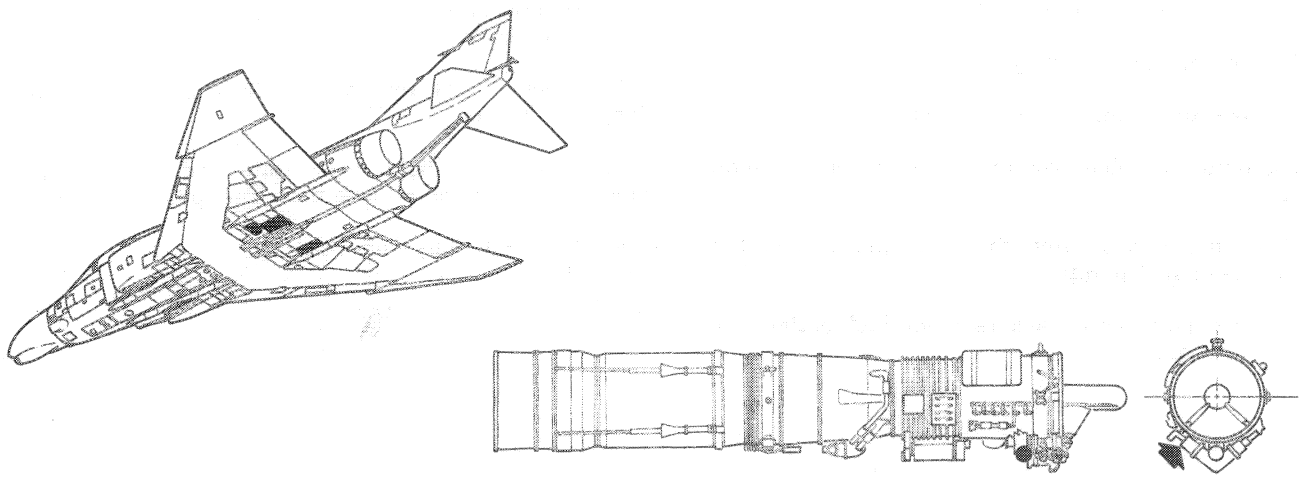
j. Remove bolts and washers from fuel outlet line flange connection.

k. Remove four bolts and washers from fuel inlet line flange connection.

l. Remove bolts and washers from bypass inlet line flange connection.

m. Remove six hold down nuts and washers from mounting studs and remove main fuel pump and gasket.

n. Remove unions from pump.



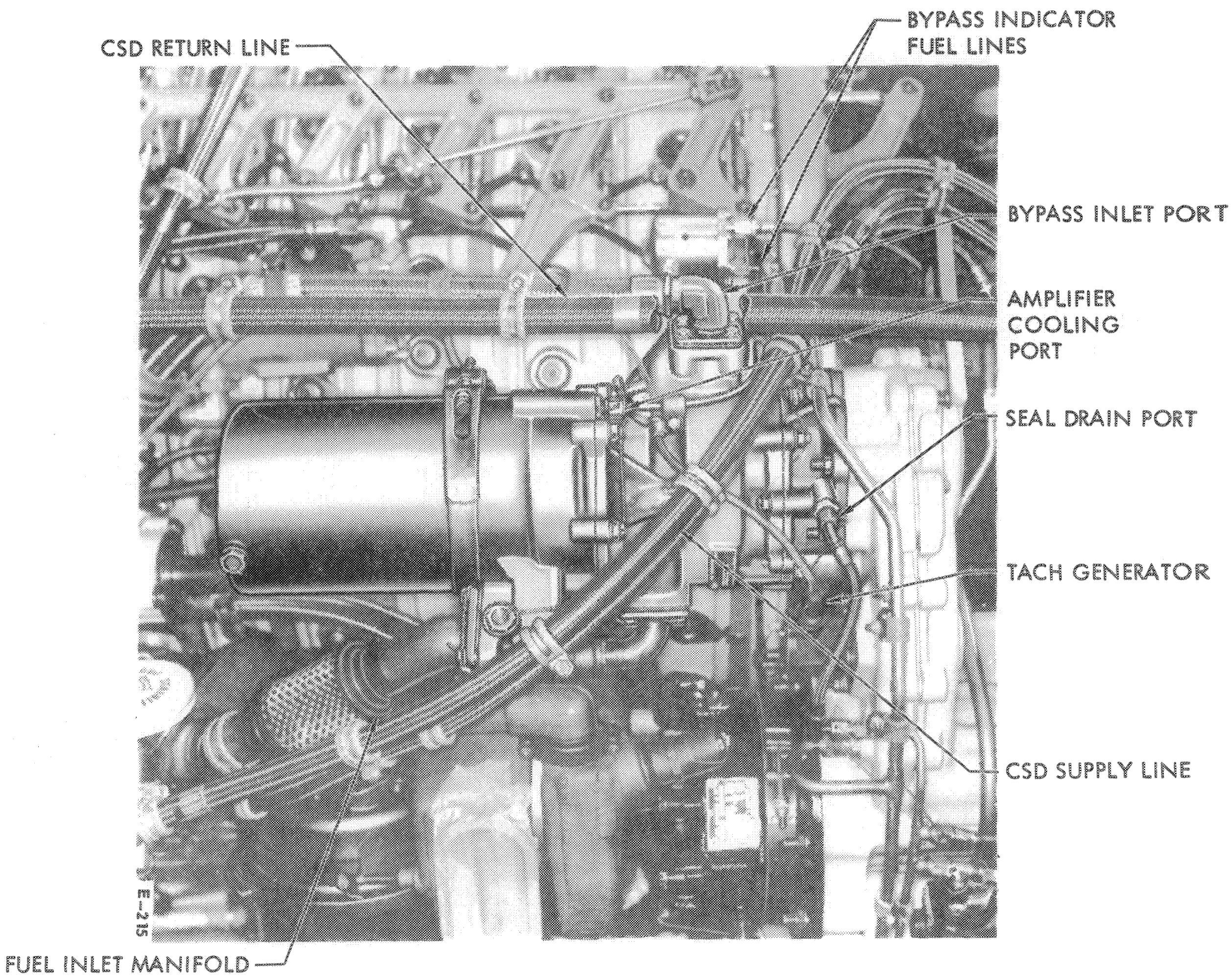


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Figure 5-3. Main Fuel Pump Removal and Installation

5-27. Installation.

a. Clean pump drive spline with a wire brush and a suitable solvent to remove dirt, grit and old lubricant; lubricate drive splines with plastilube moly No. 3 lubricant (paragraph 5—25).

b. Install unions and new O rings in two bypass indicator ports and in temperature amplifier cooling and seal drain ports of pump.

c. Install gasket over studs on mounting pad.

d. Install pump in position over studs on mounting pad and install hold down washers and nuts.

e. Install gasket and bypass inlet line flange connection in position and install washers and bolts.

f. Install gask-o-seal and fuel inlet line flange connection in position and install four washers and bolts.

g. *Torque flange connections bolts 35 to 70 inch-pounds and secure with lockwire.*

h. Install gasket and fuel outlet line flange connection in position and install washers and bolts. *Secure with lockwire.*

i. Connect two fuel lines for bypass indicator switch to unions on fuel pump. *Secure with lockwire.*

j. Connect amplifier cooling flow line to union on fuel pump. *Secure with lockwire.*

k. Install seal drain line to union in fuel pump. *Secure with lockwire.*

l. Install CSD supply and return line brackets and clamps. Refer to T.O.1F-4C-10 for proper installation.

m. Install tachometer generator.

n. Connect tachometer generator electrical lead and install bracket and clamp on fuel pump. Refer to T.O.1F-4C-10 for proper installation.

o. Install starter assembly.

p. Close fuel drain valve on engine fuel manifold. *Secure with lockwire.*

q. *Assure CSD lines and tachometer generator electrical lead have been properly rounted and secured.*

r. *Assure access doors are properly secured.*

5-28. COMPRESSOR INLET TEMPERATURE SENSING UNIT. See figure 5-4.

5-29. Materials.

Petrolatum

5-30. Manpower Requirement.

a. Two men required

5-31. Removal.

NOTE

CIT sensor and fuel servo tube must be removed and installed as an integral assembly.

a. Open doors 73 L or R, 74 L or R and 82 L or R.

b. Remove clamps from sensor capillary tubes.

c. Disconnect anti-icing indicator switch reference line from sensing coil mounting bolt.

d. Remove compressor inlet temperature sensing coil and gasket from compressor front frame.

e. Remove screws, washers and clamps holding CIT sensor.

f. Remove sensor from fuel control.

5-32. Installation.

NOTE

Assure main fuel control and sensor cavities are free from loose bolts, washers, and other foreign matter before installing sensor. Refer to T.O.1F—4C—10 for routing and minimum clearance limits of the generator wire bundle and CIT lead.

a. Install a new sensor seal ring onto sensor mounting flange. Coat seal ring with petrolatum.

b. Looking into sensor mounting pad of main fuel control, position lever roller inside control so it will align with yoke of the sensor output shaft.

c. Install sensor to main fuel control. Sensor body must make flush with control mounting flange.

d. Install four CIT mounting clamps, washers and screws.

e. *Torque screws from 20 to 30 inch-pounds and secure with lockwire.*

f. Installation compressor inlet temperature sensing coil and new gasket to compressor front flange.

NOTE

Lower rear bolt is hollow to conduct reference air pressure to anti-icing indicator switch.

g. *Torque bolts and secure with lockwire.*

NOTE

Do not permit lockwire to touch capillary tubes.

h. Connect anti-icing indicator switch reference line.

i. *Position sensor capillary tubes and secure with clamps.*

j. *Close door 73 L or R, 74 L or R, and 82 L or R.*

5-33. PRESSURIZING AND DRAIN VALVE. See figure 5-5.

5-34. Materials.

Lockwire, MS20995NC32

5-35. Removal.

a. Open door 83 L or R.

b. Cut safety wire and disconnect the four lines from valve.

c. Remove two bolts and nuts which secure aft end of valve to support bracket.

d. Cut safety wire and remove four bolts which secure forward end of valve to main oil cooler.

e. Remove pressurizing and drain valve.

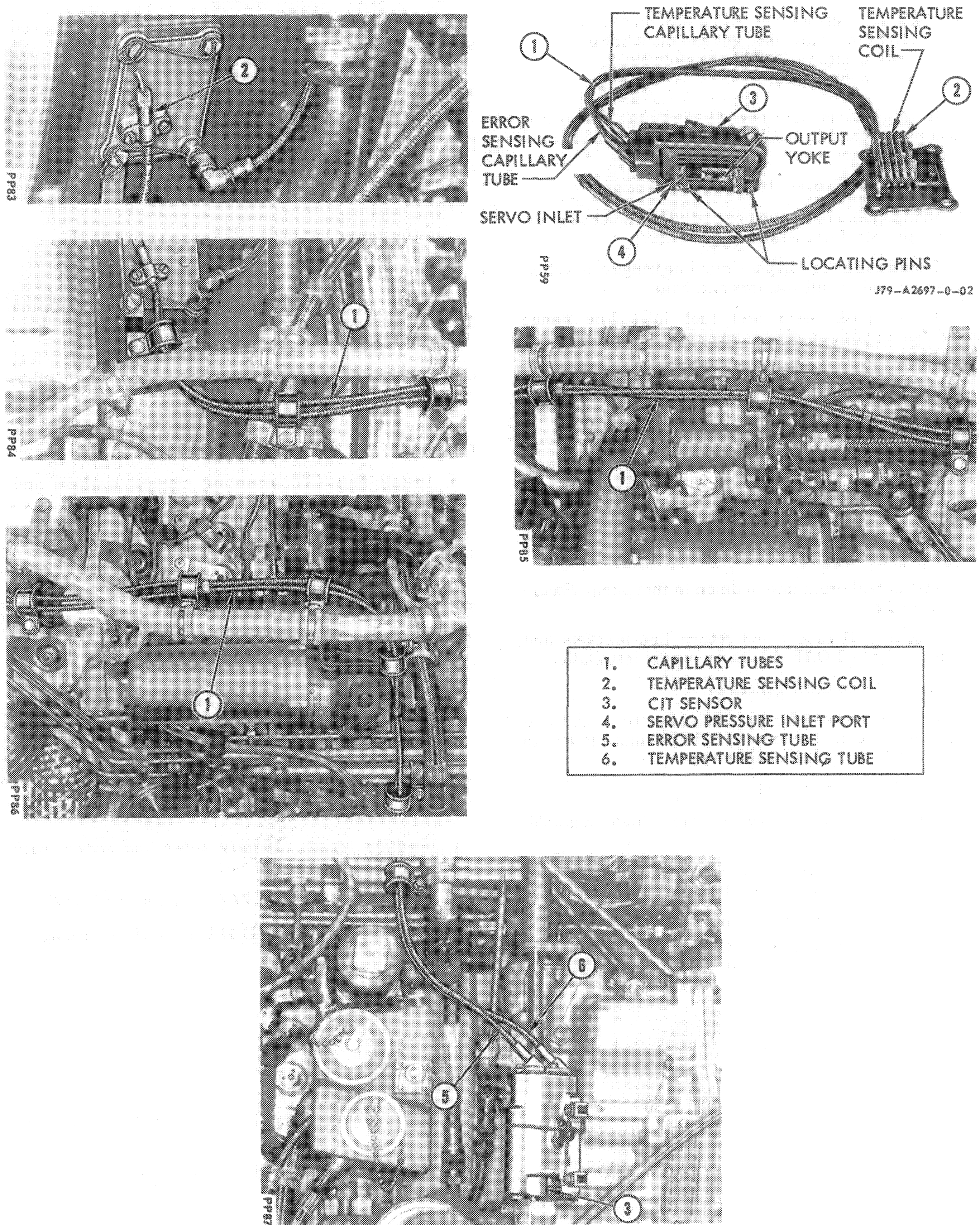
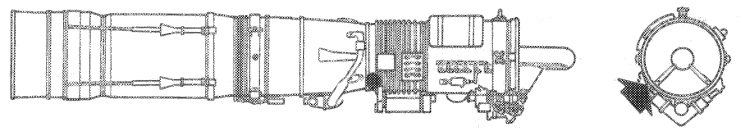


Figure 5-4. Compressor Inlet Temperature Sensing Unit Removal and Installation



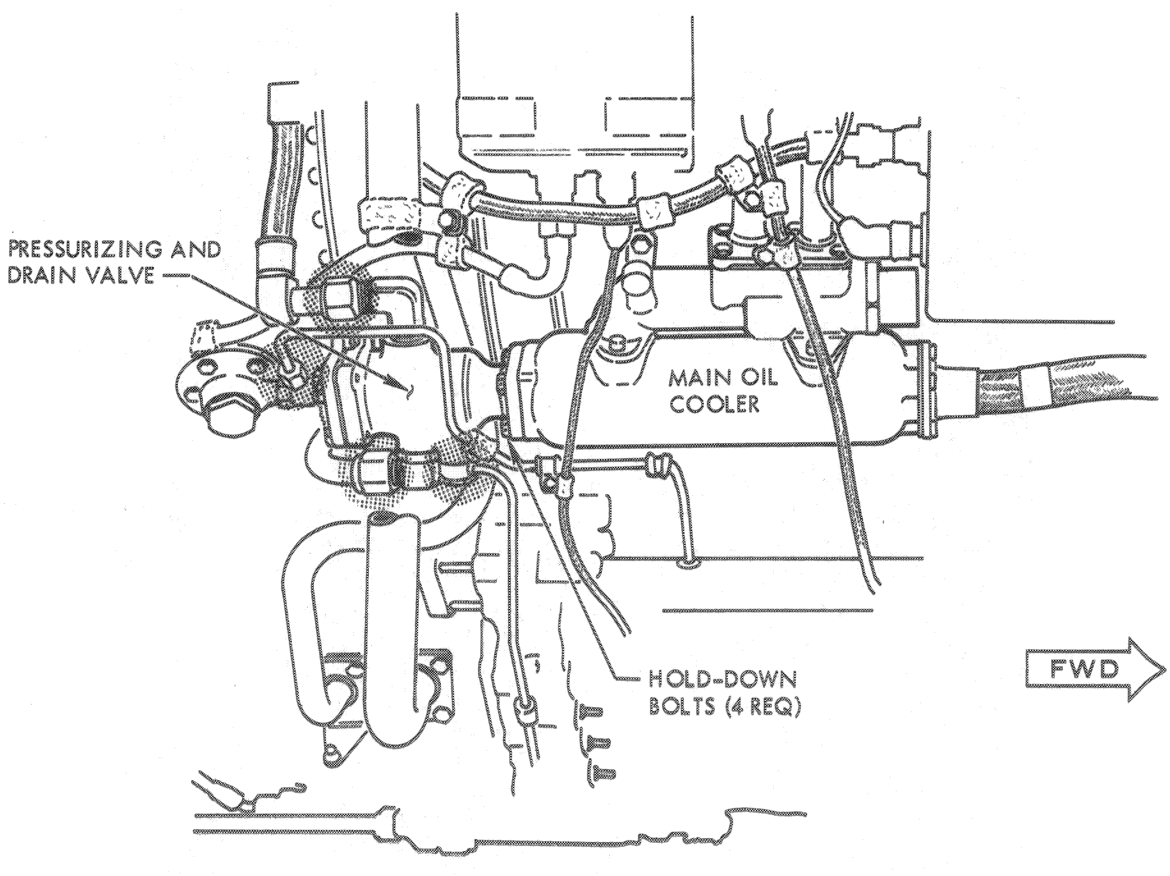


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Figure 5-5. Pressurizing and Drain Valve Removal and Installation

5-36. Installation.

a. Install new gasket between valve and fuel oil cooler.

b. Place valve in proper position and install four bolts. *Torque bolts 55 to 70 inch-pounds and lockwire.*

c. Attach aft end of valve to rear support bracket using 2 bolts and nuts. *Torque bolts 55 to 70 inch-pounds.*

d. *Connect, torque main fuel manifold to valve side fittings 34 to 36 foot-pounds, and lockwire attaching lines.*

e. *Inspect for proper installation.*

f. Close doors 22, 73L or R, 74L or R, 80 or 78 and 140.

5-37. FUEL NOZZLE. See figure 5-6.

5-38. Tools and Equipment.

Wrench, torque, 0 to 150 inch-pounds
Wrench, torque, 100 to 750 inch-pounds
Clamp, fuel nozzle positioning

5-39. Materials.

Lockwire, MS20995NC32

5-40. Removal.

NOTE

Fuel nozzles in combustion liners Nos. 4, 5, 6, and 7 are accessible through door 83 L or R when engine is installed.

a. Open door 83 L or R.

b. Remove lockwire from fuel manifold hose fitting and fuel nozzle bolts.

c. Disconnect fuel manifold hose from fuel nozzle.

d. Remove five nuts and bolts holding fuel nozzle to mounting pad on compressor rear frame.

e. Remove fuel nozzle and gasket.

5-41. Installation.

a. Insert fuel nozzle with gasket into nozzle port on compressor rear frame. Align nozzle tip with opening in combustion liner.

b. Slide nozzle toward rear of engine while holding nozzle flange flat against compressor rear frame mounting pad. If nozzle is not properly aligned, it will be impossible to hold against forward portion of pad as nozzle is moved rearward.

c. After fuel nozzle has been properly installed and checked, slide nozzle forward until mounting holes in pad, gasket, and flange align.

d. Hold nozzle firmly in place with nozzle positioning clamp and install two bolts and nuts and tighten. Nozzle must be firmly held to prevent nozzle tip from sliding out of opening in combustion liner.

e. Install remaining bolts and nuts.

f. *Torque nuts 55 to 70 inch-pounds.*

g. Connect fuel manifold hose to fuel nozzle.

h. *Torque fitting 270 to 300 inch-pounds and lockwire.*

i. *Close door 83 L or R.*

5-42. LOW PRESSURE FUEL FILTER. See figure 5-7.

5-43. Tools and Equipment.

Wrench, torque, 0 to 100 inch-pounds

5-44. Materials.

Filter
Petrolatum, VV-P-236
Lockwire, MS20995NC32

5-45. Removal.

5-46. Procedure. (Right Engine)

a. Open doors 22 and 82R.

b. Visually make sure engine fuel shutoff valve indicator in door 22 reads closed. If valve indicator reads open, perform steps f thru k of paragraph 13-43.

c. Remove filter bowl drain plug and allow fuel to drain into suitable container.

d. Loosen V band clamp bolt and remove filter bowl.

e. Remove self locking nut from filter retaining bolt and remove filter element.

f. Remove and discard O rings.

5-47. Procedure (Left Engine).

WARNING

To prevent injury to personnel, make sure safety struts are installed on door 81L and R actuators.

a. Disconnect door 81L actuator and open door 22.

b. Visually make sure engine fuel shutoff valve indicator in door 22 reads closed. If valve indicator reads open, perform steps f thru k of paragraph 13-43.

c. Remove drain plug and allow fuel to drain into container.

d. Remove V band clamp that secures filter to pump. Do not unscrew clamp bolt completely.

e. Lift aft end of filter bowl upward and turn forward end clockwise in elliptical movement as viewed from rear.

f. Hold aft end up and allow forward end of filter bowl to pass downward through space between airframe and inlet fuel disconnect assembly.

g. Remove self locking nut from filter retaining bolt and remove filter element.

h. Remove and discard O rings.

5-48. Installation.

5-49. Procedure. (Right Engine).

NOTE

Lightly coat O rings with petrolatum during installation.

a. Install drain plug. *Torque 40 to 65 inch-pounds and lockwire.*

b. Insert filter element in bowl. Secure with bolt, washer, and nut. Bolt must be inserted through center of element when element is in bowl. *Torque nut 60 to 70 inch-pounds.*

c. Install filter bowl to pump with drain plug at the 6 o'clock position. Install the V band clamp with the bolt at the 3 o'clock position with the head pointing down. *Torque clamp bolt 60 to 70 inch-pounds and lockwire.*

d. Leak check filter installation by operating engine to a minimum of 85% RPM.

e. Close doors 22 and 82R.

5-50. Procedure (Left Engine).

NOTE

Lightly coat O rings with petrolatum during installation.

a. Install drain plug. *Torque 40 to 65 inch-pounds and lockwire.*

b. Insert filter element in bowl. Secure with bolt, washer, and nut. Bolt must be inserted through center of element when element is in bowl. *Torque nut 60 to 70 inch-pounds.*

c. Install aft end of filter bowl up through space between airframe and inlet fuel disconnect assembly.

d. Turn forward end of filter bowl counterclockwise in an elliptical movement as viewed from rear and align filter bowl with pump.

e. Install filter bowl to pump with drain plug at the 6 o'clock position. Install the V band clamp with the bolt at the 3 o'clock position with the head pointing down. *Torque clamp bolt 60 to 70 inch-pounds and lockwire.*

f. Leak check filter installation by operating engine to a minimum of 85 percent RPM.

g. Reconnect door 81L actuator and close door 22.

5-51. MAIN FUEL FILTER. See figure 5-8.

5-52. Tools and Equipment.

Wrench, torque, 0 to 150 inch-pounds
Wrench, torque, 100 to 750 inch-pounds
Ultrasonic cleaner or cleaning brush

5-53. Materials.

Lockwire, MS20995NC32
Petrolatum, VV-P-236
Trichlorethylene, O-T-634: Solvent, P-D-680, Type II

5-54. Removal.

WARNING

To prevent injury to personnel, make sure safety struts are installed on door 81L and R actuator.

a. Open doors 22 and 81L or 82R.

b. Visually make sure engine fuel shutoff valve indicator in door 22 reads closed. If valve indicator reads open, perform steps f thru k of paragraph 13-43.

c. Remove lockwire and drain plug from filter bowl.

d. Allow fuel to drain into suitable container before removing filter bowl.

e. Unscrew filter bowl and remove. Support servo element and bypass valve housing with one hand as bowl is removed.

f. Unstack bypass valve housing and servo element from main element.

g. Remove 4 O rings and discard.

5-55. Cleaning.

a. Before cleaning main element cover end to prevent contaminants from entering interior of filter.

WARNING

To prevent injury to personnel, use cleaning solvent in a well ventilated area. Avoid prolonged breathing of fumes. Keep away from flame.

b. Clean filter element and bowl using solvent and brush that has soft bristles longer than depth of pleats in filter element.

c. The preferred method is ultrasonic cleaning if equipment is available. Clean filter for 5 minutes at room temperature using trichlorethylene or equivalent. Position element horizontally in cleaning tank and rotate 90 degrees after each minute of cleaning. Backflush if possible.

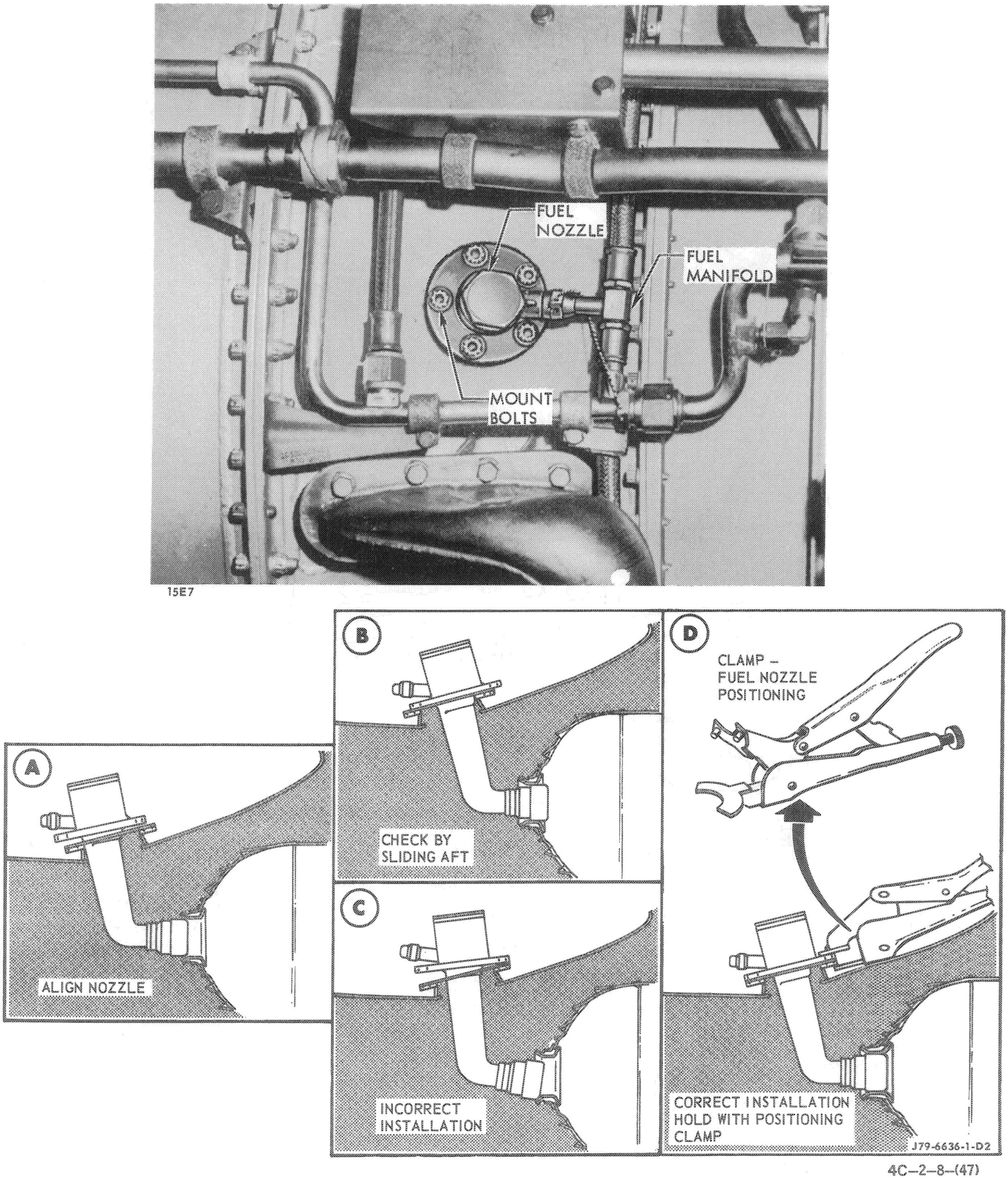

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Figure 5-6. Fuel Nozzle Removal and Installation

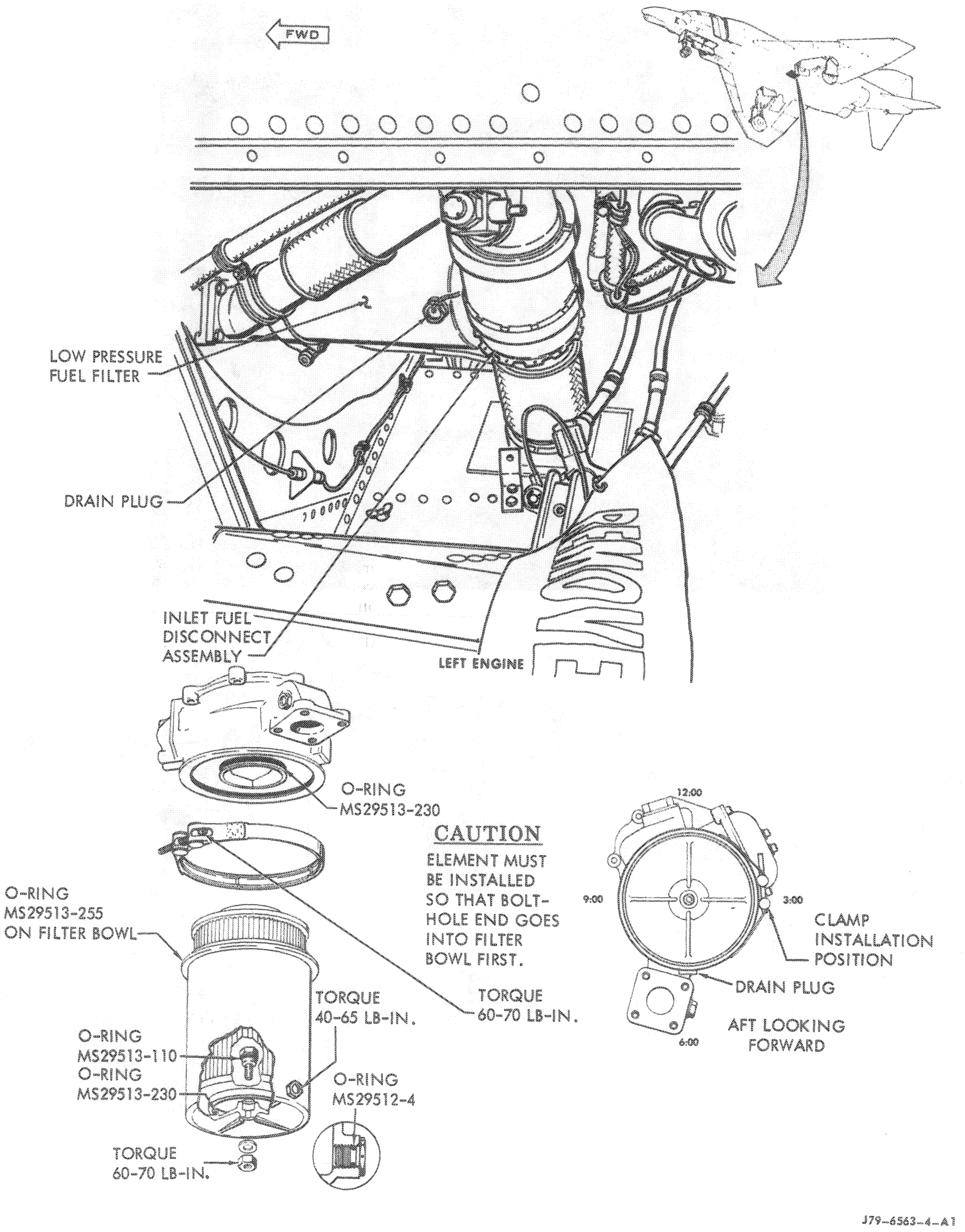


Figure 5-7. Low Pressure Fuel Filter Removal and Installation

CAUTION

Do not exceed 40 psig air pressure or damage to filter will result.

d. Shake or blow excess solvent from filter element.

5-56. Inspection.

a. Inspect filter element for tears, buckling, obstructions and contamination.

b. Inspect seal seating surfaces for burrs.

5-57. Installation.

NOTE

To facilitate installation of O rings, coat lightly with petrolatum.

a. Install new O rings.

b. Install servo filter assembly into filter head.

CAUTION

On P1 filters, main filter element, bypass valve, and spring assembly must be assembled carefully to prevent bypass valve from being locked in open position.

c. Install main filter element and bypass valve in filter head.

NOTE

On P1 filters be sure tangs seat properly and are not inserted into slots.

d. Install filter bowl in filter head.

e. *Torque filter bowl 120 to 180 inch-pounds and lockwire.*

f. Install drain plug.

g. *Torque plug 40 to 65 inch-pounds and lockwire.*

h. Leak check filter at engine run. Refer to Section II.

i. *Close doors 22 and 81L or 82R.*

5-58. CLEANING, DRAINING, AND LUBRICATION.

5-59. LOW PRESSURE FUEL FILTER CLEANING.

5-60. Tools and Equipment.

Ultrasonic cleaning unit (optional)

5-61. Materials.

Solvent, P-D-680, Type II or O-T-634A

5-62. Removal. Refer to paragraph 5-42.

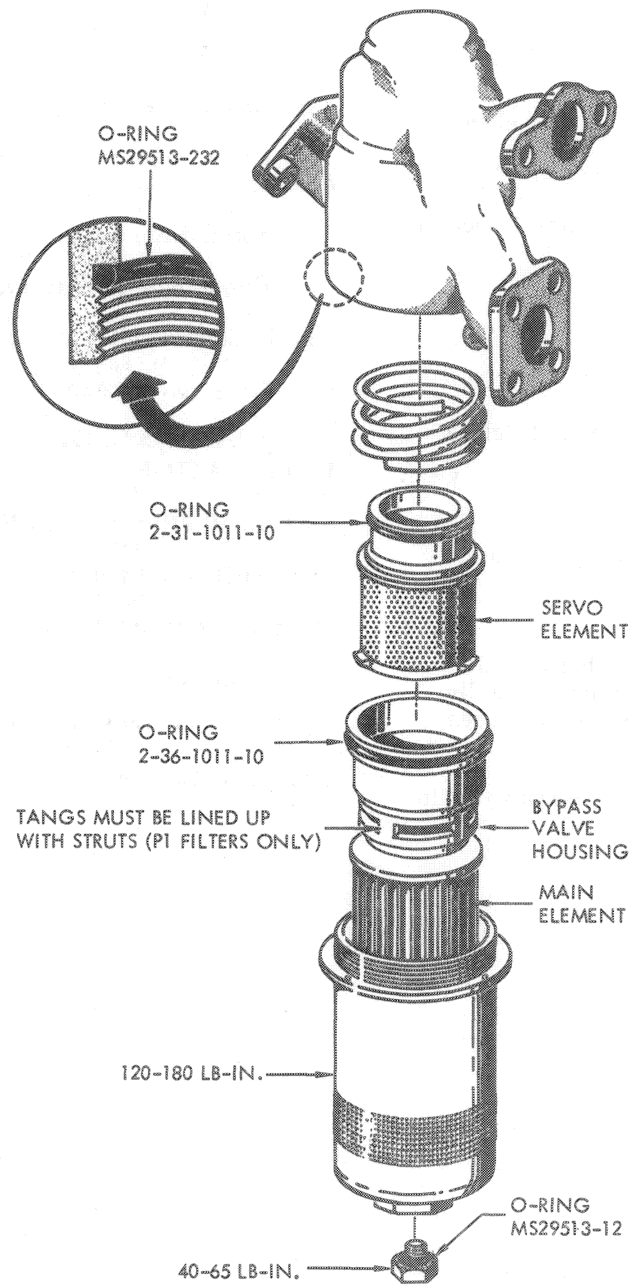


Figure 5-8. Main Fuel Filter Removal and Installation

5-63. Procedure. (Preferred Method)

NOTE

Cover ends of filter element to prevent contaminants from entering filter.

5-64. Clean filter for 5 minutes in ultrasonic cleaning equipment, using O-T-634A or equivalent. Position element horizontally in cleaning tank and rotate 90° after each minute of cleaning. Back flush if possible.

5-65. Procedure. (Alternate Method)

NOTE

Cover ends of filter element to prevent contaminants from entering filter.

5-66. Clean element and parts with a soft bristled brush and P-D-680. Assure bristles are longer than depth of pleats in filter. Shake excess solvent from element.

5-67. Inspection.

a. Inspect filter element for tears, buckling, obstructions, and contamination.

b. Inspect sealing surfaces for burrs.

5-68. Installation. Refer to paragraph 5—48.

5-68A. INSPECTION.

5-68B. Main Fuel Control Cap Screws.

a. Install safety strut on door 81 L and R. Open door 82 L and R.

b. Use scribe lightly pulling on side of two cap screws at location "A" (reference figure 5—9) using flashlight and mirror as an aid to locate cap screws.

c. Use scribe inserted into cap screw socket end, pulling lightly on two cap screws at location "B" (reference figure 5—9) using flashlight and mirror as an aid to locate cap screws.

d. Use tip of finger on eight cap screw heads at location "C" (reference figure 5—9) using flashlight and mirror to locate cap screws.

e. If any loose or broken screws are found, replace main fuel control

SHOP MAINTENANCE

5-69. MAINTENANCE PROCEDURES.

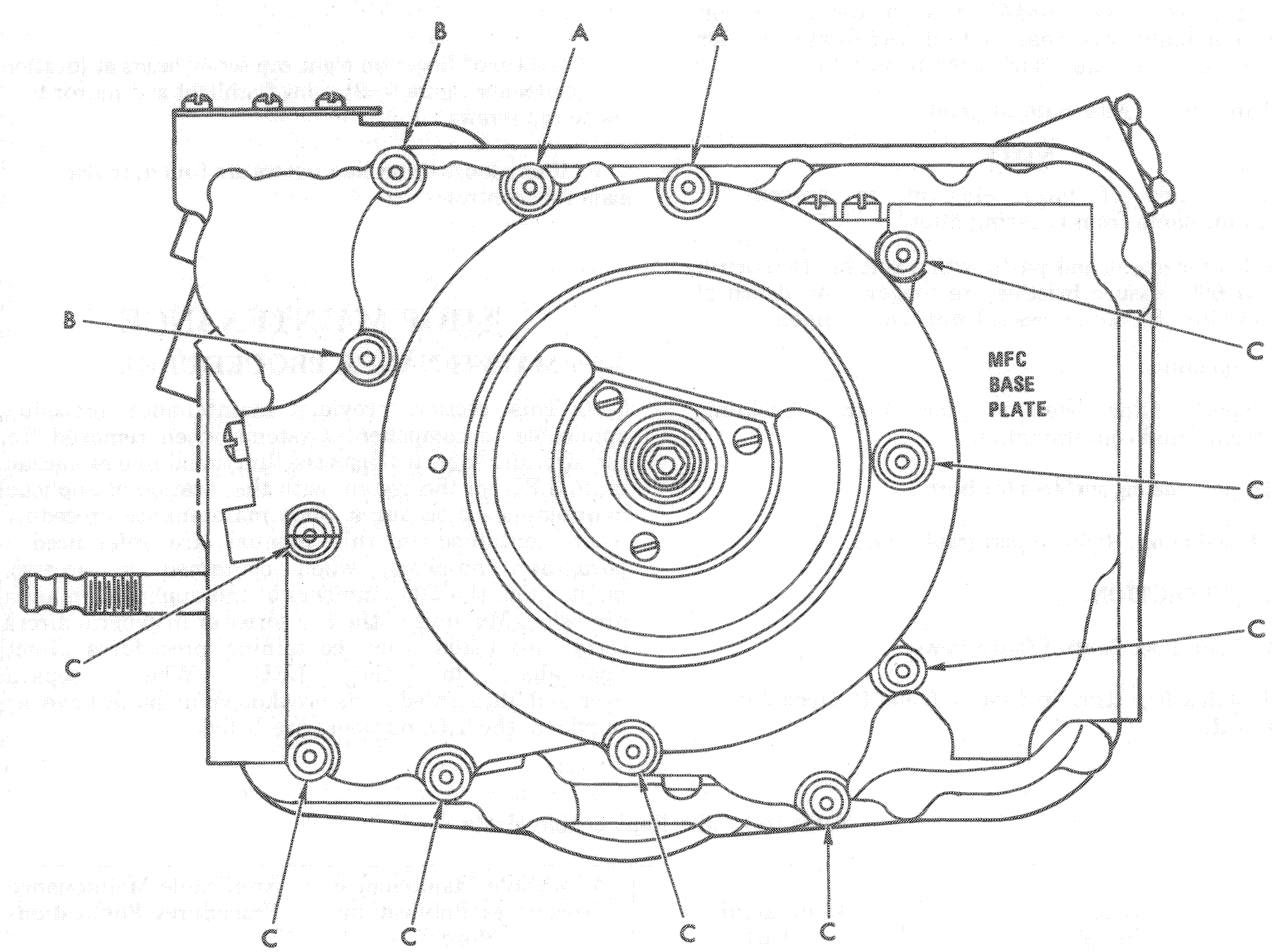
5-70. This section provides maintenance procedures applicable to components/systems when removed from the aircraft. Table 5-3 lists the functional line replaceable units (LRU) of the system with the location of applicable maintenance procedures. Shop maintenance procedures, when contained in this manual are referenced by paragraph numbers; when contained in accessory publication, the T.O. numbers of the applicable manuals are listed. Manuals in the F-4 series or in general aircraft series are listed when containing procedures directly applicable to the LRU. When separate overhaul/illustrated parts breakdown manuals have been provided, the T.O. numbers are listed.

Table 5-3. Line Replaceable Units.

Line Replaceable Unit	Manufacturers Part Number	Applicable Maintenance Procedures/Publications Shop (Intermediate Level)	Applicable Maintenance Procedures/Publications Overhaul/IPB
Low pressure fuel filter	02-13652 02-13841		T.O.2J-J79-46
Pressurizing and drain valve	3110707		T.O.2J-J79-46
Main fuel filter	5022M20		T.O.2J-J79-46
CIT sensor	512D868		T.O.2J-J79-46
Main fuel pump	512D892		T.O.2J-J79-46
Main fuel nozzle	577C796		T.O.2J-J79-46
Main fuel control	635E343		T.O.2J-J79-46

5-71. PACKAGING.

5-72. Components to be forwarded to the next higher level of maintenance for repairs, test, or check must be cleaned, preserved, and packaged for protection against physical and mechanical damage during subsequent handling, shipping, and storage. For preservation and packaging methods referred to herein, refer to AFP 71-4 volumes 1 and 2. Components packed for forwarding must further be identified, marked and documented in accordance with applicable Air Force procedures.



MAIN FUEL CONTROL BASE PLATE CAP SCREW LOCATIONS
(LOOKING FORWARD)

NOTE

LOCALLY MANUFACTURE SCRIBE TO DIMENSIONS SHOWN FROM 1/16" DIAMETER STOCK.

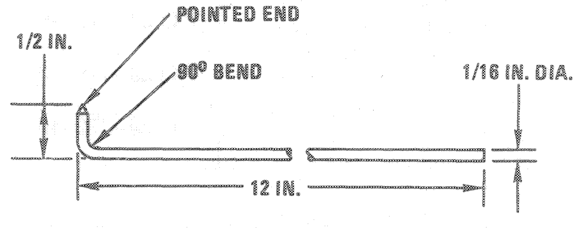


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Figure 5-9. Main Fuel Control Cap Screw Inspection

SECTION VI

AFTERBURNER FUEL SYSTEM

DESCRIPTION

6–1. **SYSTEM DESCRIPTION.** See figure 6–1.

6–2. The afterburner fuel system regulates the flow of fuel that is sprayed into the tailpipe for afterburner combustion. Main system fuel flows to the torch igniter which provides positive afterburner ignition. The afterburner increases engine thrust by increasing the temperature and velocity of the exhaust gases.

6–3. **COMPONENT DESCRIPTION.**

6–4. The afterburner fuel system comprises the following components:

a. Afterburner fuel pump.

b. Pump vent valve.

c. Afterburner reference fuel filter.

d. Afterburner fuel filter.

e. Afterburner fuel control.

f. Afterburner fuel pressurizing valve.

g. Fuel manifolds and spraybars.

h. Torch igniter on–off valve.

i. Torch igniter check valve.

j. Torch igniter.

6–5. **AFTERBURNER FUEL PUMP.** The afterburner fuel pump supplies fuel, under pressure, to the afterburner fuel system. The afterburner fuel pump is a gear–driven, impeller–type pump. It rotates continuously but is drained of fuel when afterburning is not scheduled. A fuel inlet valve, mounted on the pump inlet, controls the passage of fuel from the aircraft fuel system into the afterburner fuel system. The pump is on the left rear face of the transfer gearbox.

6–6. **PUMP VENT VALVE.** The pump vent valve drains the afterburner fuel pump cavity, and vents the torch igniter on–off valve signal line to overboard drain manifold during non–afterburning operation. It closes to prevent fuel from escaping during afterburning.

6–7. **REFERENCE PRESSURE FUEL FILTER.** The reference pressure fuel filter prevents contamination from entering the main and afterburner fuel systems during reverse fuel flow operation during engine start.

6–8. **AFTERBURNER FUEL FILTER.** The afterburner fuel filter removes contamination from the afterburner fuel flow. The filter contains a corrugated filter element and a bypass valve. The filter is mounted on the inlet of the afterburner fuel control.

6–9. **AFTERBURNER FUEL CONTROL.** The afterburner fuel control meters fuel flow for the afterburner and divides the flow into core and annulus supplies. The fuel is scheduled as a function of throttle angle and compressor discharge pressure (CDP). During any flight condition, the afterburner fuel control can meter any fuel flow between the minimum necessary to maintain combustion and the maximum allowable.

6–10. **AFTERBURNER FUEL PRESSURIZING VALVE.** The afterburner fuel pressurizing valve keeps the system components filled and divides the flow between primary and secondary flows.

6–11. **AFTERBURNER FUEL MANIFOLDS AND SPRAYBARS.** The afterburner fuel manifolds distribute and deliver the fuel flow to the nozzles.

6–12. **TORCH IGNITER ON–OFF VALVE.** The torch igniter on–off valve filters, meters, and controls torch igniter fuel flow to permit torch igniter combustion only during afterburner operation. It is at the bottom of the compressor rear frame in the torch igniter fuel supply line.

6–13. **TORCH IGNITER CHECK VALVE.** The torch igniter check valve shuts off fuel flow to shutdown.

6–14. **TORCH IGNITER.** During afterburner operation the torch igniter provides an intense flame that ensures positive combustion of afterburner fuel. The torch igniter is located at the 6 o'clock position in the tailpipe, directly behind the spraybars. The torch igniter is a small combustion chamber which contains a fuel nozzle and a spark plug. An airfoil shaped strut attaches the burner body to the mounting flange.

OPERATION

6–15. **SEQUENCE OF OPERATION.** See figure 6–1.

6–16. **AFTERBURNER FUEL PUMP.** Fuel from the aircraft fuel system is directed to the inlet valve of the pump. When the pressure signal from the main fuel control is less than 20 psi above reference pressure, the inlet valve remains closed and no fuel can enter the pump. When the fuel signal pressure reaches 80 psi above reference, the inlet valve is open and fuel is allowed to enter the pump. A pressure regulator in the inlet valve limits fuel flow surge by controlling the pressure of the signal. Signal flow is regulated by the pressure regulator to approximately 600 pph to actuate the inlet valve piston.

6–17. When fuel enters the pump, the impeller forces it through the outlet under high pressure. A check valve at the discharge port opens to permit the fuel to flow to the system, but is closed during non–afterburning to prevent fuel remaining in the system from draining into the pump.

6–18. **PUMP VENT VALVE.** The pump vent valve is assembled in the pump drain line near the drain manifold. When discharge pressure is below 145 psi, the valve is open and the pump cavity and on–off valve signal pressure hose are vented to the overboard drain tube. When pump discharge exceeds 165 psi, the valve is closed and fuel cannot drain from the pump or the signal hose.

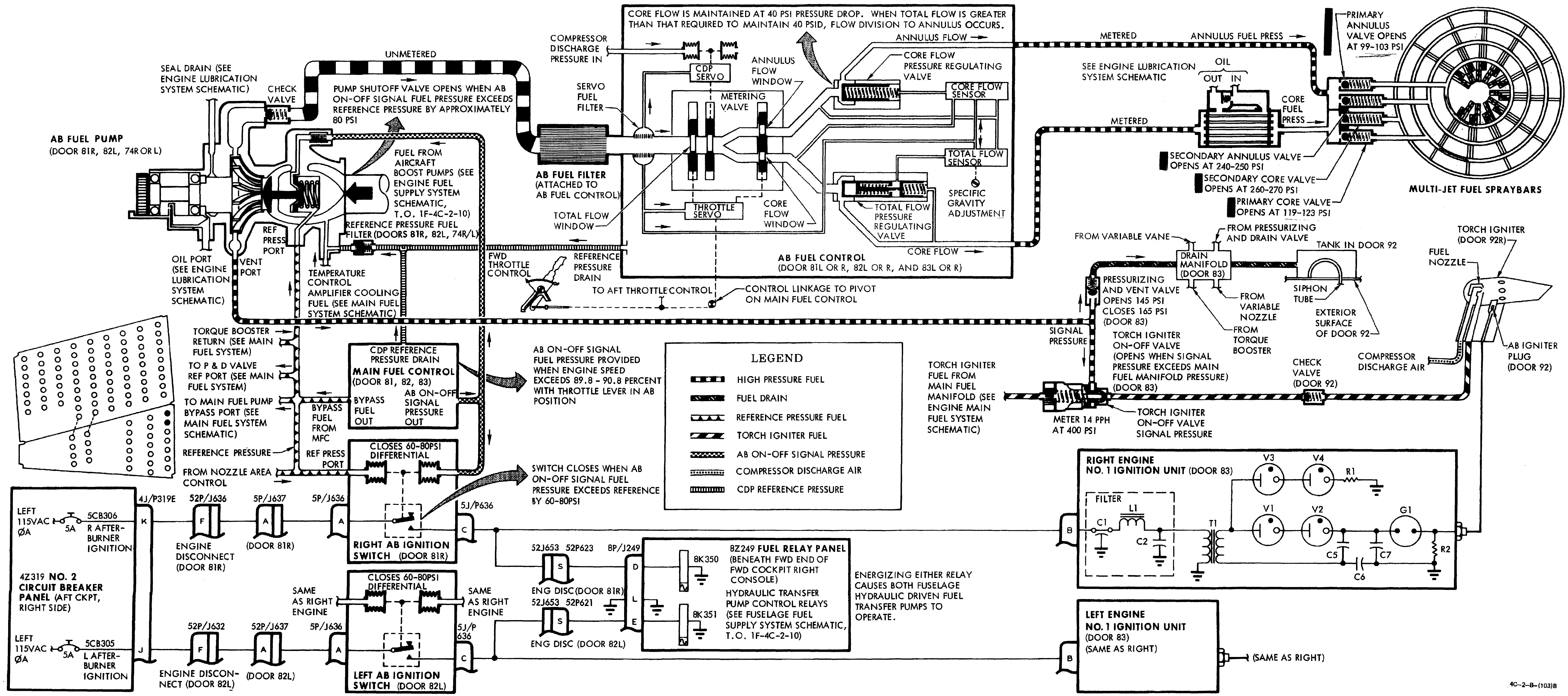


Figure 6-1. Afterburner Fuel System Schematic

6-19. **AFTERBURNER REFERENCE FUEL FILTER.** The reference pressure fuel filter is located at the tee connector in the reference fuel return port of the afterburner fuel pump. The filter incorporates a 40 mesh wire screen filter element and a bypass valve. During normal engine operation, reference pressure fuel is returned to the afterburner fuel pump from the CDP section of the main fuel control and the afterburner fuel control. Reference pressure fuel returning to the afterburner fuel pump is bypassed around the filter element. When the engine is being started, a reverse flow of fuel occurs in the reference fuel return line. During this reverse fuel flow, the fuel from the aircraft fuel supply system that flows to the control system is filtered.

6-20. **AFTERBURNER FUEL FILTER.** Fuel enters around the filter element and flows into the center. When the element becomes blocked, the bypass valve deflects and permits fuel to flow directly to the center.

6-21. **AFTERBURNER FUEL CONTROL.** Most of the fuel entering the control flows through the open-centered inlet filter to the throttle valve and to one end of the total flow pressure regulating valve sensor. A small amount of fuel flows outward through the sides of the inlet filter and to the control body where it is used for servo operation.

6-22. The throttle valve consists of a movable valve within a fixed sleeve. The sleeve contains 3 sets of windows; the valve has 2 sets of windows, only one window of each set is shown for clarity. The relative alignment of the windows determines the amount of fuel that is scheduled. One window regulates total flow; the area of this window varies in one dimension only but is regulated by integrating CDP and throttle position inputs. The middle window regulates core flow; the area varies in both an axial and rotational dimension and is regulated by integrating CDP and throttle position inputs. The 3rd window conducts annulus flow and has no metering function so its area remains constant.

6-23. At minimum CDP and throttle position the total flow window is slightly open in the axial dimension and fully open in the rotational dimension. As CDP increases, the axial dimension of the total flow window is increased for any given throttle position. This produces a throttle schedule which causes a greater fuel flow increase at the higher throttle angles than the lower ones.

6-24. At minimum CDP and throttle position, the core flow window is open slightly in the axial dimension and open fully in the rotational dimension. An increase of CDP increases the axial dimension. Throttle movement for a given CDP both translates and rotates the valve. As the axial dimension of the core window is increased, due to a throttle increase, the rotational dimension is decreased, maintaining approximately a constant area. Changes in CDP produce a different effective area, but the throttle schedule is essentially the same.

6-25. **Throttle Valve Positioning.** The throttle valve is spring-loaded closed (toward the right). A roller assembly of the throttle setting servo piston rolls between a platform on the right end of the throttle valve and the multiplying lever. CDP varies the effective slope of the multiplying lever, throttle position varies the position of the roller assembly on the lever. A throttle valve rotating cam attached to the throttle setting servo piston rotates the throttle valve.

6-26. **Compressor Discharge Pressure Section.** Compressor discharge pressure (CDP) is ported to the CDP sensor where it is applied to the outside of the sensing bellows. An evacuated bellows reduces the signal to absolute air pressure. When CDP increases, the sensing bellows is compressed and the upper end of the CDP feedback lever is moved to the left. This restricts fuel flow from the CDP servo orifice, thus causing fuel pressure to increase on the right end of the CDP servo piston and move it toward the left. As the piston moves to the left, it increases the slope of the multiplying lever and at the same time increases the force of the balance spring attached to the CDP feedback lever. The balance spring overcomes the force of the sensing bellows and returns the CDP feedback lever to its former position, reopening the CDP servo orifice.

6-27. In event of a CDP sensing bellows failure, CDP would be applied around the evacuated bellows. This would provide a satisfactory response to CDP for completion of a mission.

6-28. The lower end of the multiplying lever pivots about the minimum ratio adjustment. When the throttle setting servo piston positions the roller assembly at the minimum throttle position, changes in CDP below 55 psia will not change the position of the throttle valve.

6-29. **Throttle Input Section.** Throttle movement rotates the throttle shaft and the throttle setting cam. Advancing the throttle beyond 82 degrees raises the center of the feedback lever. This raises the throttle setting pilot valve and vents servo pressure from the top side of the throttle setting servo piston to drain pressure. When servo pressure is vented, the shutoff bypass valve remains closed and causes servo fuel to flow through the time delay orifice. The orifices limit the rate of fuel flow increase, thus producing a smooth light-off.

6-30. The throttle setting servo piston actually consists of 2 concentric servo pistons. When afterburning is first initiated, the outer piston rises until it strikes the inner piston, carrying it along. This design causes a one-second delay from the initiation until the control is able to schedule an increase in fuel flow. During this time the roller assembly does not contact the multiplying lever.

6-31. The time delay orifices delay the increase by approximately 2 seconds. When the throttle is retarded, approximately 2 seconds is required for the control to return to minimum fuel flow.

6-32. As the throttle setting servo piston moves upward, it moves the roller assembly along the multiplying lever and opens the throttle valve to increase fuel flow. The piston also lifts the left end of the throttle feedback lever, which now pivots at its center and repositions the throttle setting pilot valve to restore servo pressure to the top of the throttle setting servo piston. A cam located on the side of the throttle setting servo piston shaft rotates the throttle valve to provide scheduling of core fuel flow.

6-33. When afterburning is terminated, the shutoff bypass valve moves to the right and ports the throttle setting servo piston directly to inlet pressure ensuring that the throttle setting servo piston is retracted to the minimum flow position for re-initiating of afterburner.

6-34. **Fuel Flow Metering.** The throttle valve, which is positioned by 2 inputs (throttle position and compressor discharge pressure), varies both the amount of opening and the pressure differential across the metering orifices. The total flow pressure regulating valve sensor, however, senses the pressure change and alters servo pressure on the total flow pressure regulating valve piston to maintain a 40 psi difference between control inlet pressure and metered fuel pressure.

6-35. When the pressure difference between inlet pressure and metered pressure becomes greater than 40 psi (a higher inlet pressure), the pressure regulating valve sensor is moved to the left, porting inlet pressure to the area between the pressure regulating valve piston and valve. This pressure causes the valve to move downward closing the area at its bottom, this increases core pressure and, consequently, metered fuel pressure. When the servo pressure acting between the valve and the piston separates them, the spring within the valve overcomes the unbalanced forces on the piston and pulls it downward, where a new state of equilibrium is established. When the pressure differential is less than 40 psi (a lower inlet pressure) the pressure regulating valve is moved upward lowering core pressure.

6-36. The specific gravity adjustment provides a means of adapting the pressure regulating valve sensor spring to different specific gravity fuels. Varying spring force ensures the proper weight-flow of the grade fuel being used. A fuel-temperature-compensating bimetallic spring automatically adjusts the spring force to maintain constant weight-flow of fuel for different fuel temperatures.

6-37. **Flow Division.** Since the core flow metering window is in series with the total flow metering window and the total flow pressure regulating valve, the pressure drop across the core flow window increases as fuel flow increases. When the pressure drop across the core flow window reaches 40 psi, the core flow pressure regulating valve sensor moves to the left and ports the top of the core flow pressure regulating valve to core pressure. This permits total fuel flow in excess of that required to maintain a 40 psi differential across the core metering window to flow to the annulus outlet. When the pressure differential is less than 40 psi, inlet fuel pressure is ported to the top of the regulating valve.

6-38. As total flow is increased, due to throttle movement, the throttle valve position is translated, increasing the axial dimension of both the total flow and the core flow windows. At the same time the throttle valve rotating cam on the throttle shaft rotates the throttle valve, decreasing the rotational dimension of the core flow window. This maintains the amount of fuel flow scheduled to the core outlet as total fuel flow increases.

6-39. **AFTERBURNER FUEL PRESSURIZING VALVE.** The afterburner fuel pressurizing valve keeps the system components filled and divides the flow between primary and secondary flows.

6-40. The valve consists of 4 pressurizing pistons. Fuel is directed to 2 of them by the core fuel line and to the other 2 by the annulus fuel line. Fuel is admitted to the primary core manifold when core fuel pressure exceeds 121 ± 2 psi, and to the secondary core manifold when the fuel pressure exceeds 265 ± 5 psi. Fuel is admitted to the primary annulus manifold when annulus fuel pressure exceeds 101 ± 2 psi, and to the secondary annulus manifold when fuel pressure exceeds 245 ± 5 psi.

6-41. When CDP drops below 76 psia, the fuel pressures are so low that only the primary core and primary annulus manifolds discharge fuel.

6-42. **AFTERBURNER FUEL MANIFOLDS AND SPRAYBARS** The afterburner fuel manifolds deliver the fuel flow to each nozzle. The nozzles inject the fuel into the exhaust gas stream.

6-43. The fuel is distributed by the 4 fuel manifolds to 21 multijet fuel nozzles. Each nozzle contains 4 tubes, one for each manifold. Holes in the side of the tubes spray the fuel into the exhaust gases. Core tubes spray fuel near the center of the tailpipe; the annulus tubes spray fuel near the outside of the tailpipe.

6-44. **TORCH IGNITER ON-OFF VALVE.** The torch igniter on-off valve is a two position, hydraulically operated, fluid metering valve. It contains a relieving type inlet filter and an integral flow metering cartridge. This cartridge is composed of staggered metal orifice plates and spacers which meter fuel flow through the valve to the torch igniter.

6-45. The torch igniter on-off valve is actuated by discharge fuel pressure from the afterburner fuel pump. When the engine throttle is advanced to afterburner range, a pressure signal from the main fuel control actuates the afterburner ignition switch and opens the inlet valve to the afterburner pump, admitting fuel to the afterburner fuel pump. The increase in afterburner pump discharge pressure closes the pump vent valve and applies the pressure signal to the torch igniter on-off valve operating piston. Opposing this piston movement is engine main fuel manifold pressure plus a compression spring. The signal pressure overcomes these opposing forces and moves the piston to open the valve. As the piston travels to its stop, fuel, displaced by the piston, is discharged from the valve filling and downstream piping to the torch igniter. With the piston in its extreme travel position, fuel flow to the torch igniter is metered by the cartridge orifice pack to support combustion in the torch igniter (approximately 14 pph at 400 psi main fuel manifold pressure). The preceding sequence of events occurs in approximately 0.5 second.

6-46. Contaminants are prevented from entering the metering orifices by a 66 micron relieving type filter at the valve inlet. This filter will bypass when the pressure differential across the element exceeds 12 ± 2 psi. On some engines the on-off valve is protected from signal fluid contamination by a 40 micron filter, incorporated as part of a union fitting installed in the valve signal port.

6-47. When the throttle is retarded below the afterburner range, fuel flow to the afterburner pump is interrupted, venting the pump discharge overboard. This action reduces the signal pressure to the torch igniter on-off valve and allows the valve to close from the combined pressures of the valve compression spring and inlet fuel against the piston. With the piston in the closed position, the valve is again primed for refilling the downstream piping the next time afterburner operation is called for.

6–48. **TORCH IGNITER CHECK VALVE.** The torch igniter check valve opens at a pressure differential of 6 to 8 psi. It will allow 200 pph fuel flow with a pressure drop of less than 10 psi. Maximum leakage with a pressure differential of 2.5 psi is 5 drops per minute.

6–49. **TORCH IGNITER.** Fuel metered by the torch igniter metering valve (or by the torch igniter on–off valve) enters the fuel nozzle. Some CDP air, which is piped to the torch igniter, flows through a tube in the fuel nozzle where it forces the fuel into the torch igniter liner in a fine spray. This forced spray reduces the formation of carbon deposits on the fuel nozzle face.

6–50. The remainder of the CDP air enters the strut and flows to the inner liner, where it is mixed with the atomized fuel. The resultant mixture is ignited by the spark plug, and the burning mixture emerges from the open end of the liner as an intense flame. A tab on the torch igniter snout conducts the flame to the middle flameholder ring.

6–51. Torch igniter operation is continuous during afterburning. Although the ignition is only provided during afterburning, the torch igniter may light from the heat of the main engine. Fuel flows to the torch igniter only during afterburning, therefore, the torch igniter is extinguished when afterburning is terminated. Because both fuel and air are scheduled to the torch igniter on the basis of CDP, the intensity of the torch igniter flame is unaffected by altitude and airspeed.

6–52. **PRINCIPLES OF OPERATION.** See figure 6–1.

6–53. To initiate afterburner operation, the throttle must be advanced beyond 76.5° ±1.5° and the engine speed must exceed 90.3 percent. When engine speed exceeds 90.3 percent, a valve in the main fuel control opens and ports high pressure fuel to a second valve in the control. When the throttle is advanced beyond 76.5° (nominal) throttle angle, this second valve in the control opens and permits the high pressure fuel to flow to the inlet valve actuator of the afterburner fuel pump and to the afterburner ignition switch.

6–54. When the inlet valve of the pump is open, fuel can flow from the aircraft boost system into the pump. The pump continues to rotate, but is drained of fuel, when the inlet valve is closed. The pump vent valve closes when the afterburner fuel pump discharge pressure rises. Afterburner fuel pump discharge pressure is routed to the torch igniter on–off valve to initiate torch igniter fuel flow. When pump discharge pressure drops, the pump vent opens, which drains the pump, removes the signal pressure from the on–off valve, and discontinues torch igniter fuel flow. When the pump vent valve closes, the pump discharges fuel through the afterburner pump check valve to the afterburner filter. From the filter, fuel flows to the afterburner fuel control.

6–55. The afterburner fuel control regulates fuel flow according to throttle position and compressor discharge pressure (CDP), and divides the flow into core and annulus supplies. The fuel control varies fuel flow by regulating the area of a metering orifice while maintaining a constant pressure differential across the orifice. Core fuel from the control flows through the afterburner oil cooler and to the pressurizing valve.

6–56. When the pressure differential between the total flow and the core flow reaches 40 psi, the control schedules the additional fuel to the annulus manifold. The fuel air ratio within the core area is maintained by scheduling the size of the core throttling valve orifice proportionate to CDP. The annulus fuel flow is piped directly to the afterburner fuel pressurizing valve.

6–57. The fuel pressurizing valve consists of four valves which divide the core fuel flow into primary core and secondary core and the annulus fuel flow into primary annulus and secondary annulus. This division ensures that adequate pressures are maintained to prevent vaporization within the multijet nozzle tubes. Each pressurizing valve ports fuel to a fuel manifold, which delivers fuel to the nozzles.

6–58. Each spraybar contains four separate tubes, one for each manifold. Holes in the sides of the tubes spray the fuel into the exhaust gas stream; the primary and secondary core tubes inject fuel near the center of the exhaust gas stream; the primary and secondary annulus tubes spray fuel into the outer portion of the exhaust gas stream.

6–59. The afterburner fuel air mixture is ignited by a torch igniter, which extends into the exhaust duct. The flame of the torch igniter is provided by combining fuel, which is piped from the main fuel manifold when scheduled by the torch igniter on–off valve; air, which is piped from the outer combustion casing; and ignition, provided by the ignition system. Refer to section III.

6–60. Torch igniter fuel is filtered and metered by the torch igniter on–off valve, and is routed through a check valve prior to entering the torch igniter. The torch igniter fuel nozzle combines fuel with air to produce a combustible mixture within the torch igniter liner, where ignition takes place. Some of the air supply passes through a tube in the nozzle and propels the fuel through the nozzle tip. The high velocity spray produces an intense flame at the liner snout.

6–61. Fuel flows to the torch igniter only during afterburner operation, as metered through the torch igniter on–off valve. Once ignited, the flame is normally self sustaining; however, continuous ignition is provided during afterburner operation to insure satisfactory burning. The torch igniter snout is enlarged to spread the flame near the flameholder, and a tab on the snout directs the flame to the middle flameholder ring.

TOOLS AND TEST EQUIPMENT

6–62. **GENERAL.**

6–63. To perform maintenance on the system or components, the special tools and test equipment listed in table 6–1 should be used. Alternate equipment with equal or greater range and accuracy than that in the Alternate Equipment column may be substituted. The tools and test equipment are for performing aircraft and shop maintenance procedures in this section of the manual.

Table 6-1. Tools and Test Equipment

Name	Identification No.	Alternate Equip. Range	Alternate Equip. Accuracy	Use
Wrench, torque		0 to 3000 inch-pounds		
Wrench, torque		0 to 100 inch-pounds		
Wrench, torque		0 to 400 inch-pounds		
Wrench, torque		0 to 200 inch-pounds		
Wrench, torque		0 to 150 inch-pounds		
Wrench, torque		100 to 750 inch-pounds		
Wrench	1C3837P			Holding wrench
Wrench, strap		1 to 5 inch diameter		

AIRCRAFT MAINTENANCE

6-64. REMOVAL AND INSTALLATION.

6-65. AFTERBURNER FUEL PUMP. See figure 6-2.

6-66. Tools and Equipment.

Wrench, torque, 0 to 100 inch-pounds
Wrench, torque, 0 to 400 inch-pounds

6-67. Materials.

Gask-o-seal, 460-015-40
Lockwire, MS20995NC32

6-68. Removal.

WARNING

To prevent injury to personnel, make sure safety struts are installed on door 81L and R actuators.

a. Open doors 22 and 81R or 82L.

CAUTION

Do not remove check valve from pump; it is an integral part of pump and must be removed only during overhaul.

b. Visually make sure engine fuel shutoff valve indicator in door 22 reads closed. If valve indicator reads open, perform steps f thru k of paragraph 13-43.

c. Disconnect fuel manifold on fuel outlet line at check valve.

d. Disconnect the following: vent tube, seal drain hose, oil port reference pressure hose, torch igniter on-off valve signal pressure hose, and temperature amplifier cooling flow hose.

e. Remove CIT sensor capillary tube clamps along fuel outlet hose and tie tubes out of way to provide clearance.

f. Loosen but do not remove coupling clamp; spread clamp just enough to premit removal of pump.

g. Remove pump and coupling clamp.

6-69. Installation.

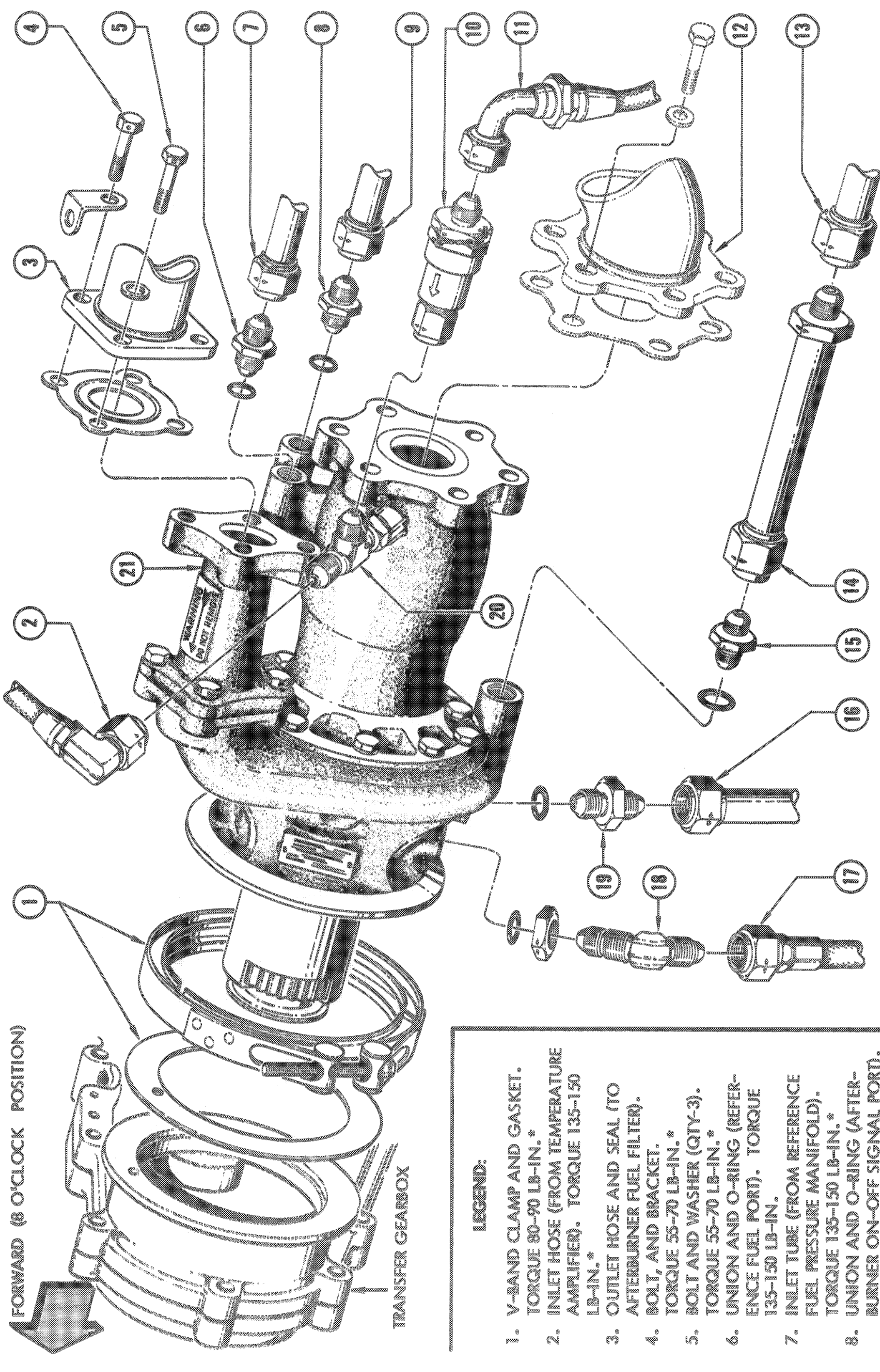
CAUTION

Exercise care when installing pump. Do not damage oil jets in gear box. Do not disengage gasket from dowel pin.

Repeated extensive flexing of clamp will weaken it. The clamp should always be installed over pump flange before pump is mounted to gearbox. This limits amount of spreading required for installation.

a. Spread coupling clamp and slip it over mounting flange of pump.

b. Install pump on gearbox; position coupling clamp bolt at 9 o'clock with bolt head pointing down. *Torque 80 to 90 inch-pounds and lockwire.*



LEGEND:

1. V-BAND CLAMP AND GASKET. TORQUE 80-90 LB-IN.*
2. INLET HOSE (FROM TEMPERATURE AMPLIFIER). TORQUE 135-150 LB-IN.*
3. OUTLET HOSE AND SEAL (TO AFTERBURNER FUEL FILTER).
4. BOLT, AND BRACKET. TORQUE 55-70 LB-IN.*
5. BOLT AND WASHER (QTY-3). TORQUE 55-70 LB-IN.*
6. UNION AND O-RING (REFERENCE FUEL PORT). TORQUE 135-150 LB-IN.
7. INLET TUBE (FROM REFERENCE FUEL PRESSURE MANIFOLD). TORQUE 135-150 LB-IN.*
8. UNION AND O-RING (AFTERBURNER ON-OFF SIGNAL PORT). TORQUE 180-200 LB-IN.
9. INLET TUBE (FROM AFTERBURNER ON-OFF SIGNAL MANIFOLD). TORQUE 270-300 LB-IN.*
10. REFERENCE FUEL CHECK VALVE. TORQUE 270-300 LB-IN.*
11. INLET HOSE (REFERENCE FUEL RETURN). TORQUE 270-300 LB-IN.*
12. FUEL INLET MANIFOLD, SEAL BOLT AND WASHER (QTY-6). QEC KIT.
13. VENT AND DRAIN TUBE (TO FUEL DRAIN MANIFOLD). TORQUE 270-300 LB-IN.*
14. EXTENSION TUBE. TORQUE 270-300 LB-IN.*
15. REDUCER AND O-RING. TORQUE 155-175 LB-IN.*
16. TUBE (TO SEAL DRAIN MANIFOLD). TORQUE 135-150 LB-IN.*
17. INLET HOSE (FROM LUBE MANIFOLD). TORQUE 135-150 LB-IN.*
18. ELBOW, JAM NUT AND O-RING (LUBE PORT). TORQUE JAM NUT 135-150 LB-IN.*
19. UNION AND O-RING (SEAL DRAIN PORT). TORQUE 135-150 LB-IN.
20. T-FITTING AND JAM NUT. (DO NOT REMOVE EXCEPT AT OVERHAUL). TORQUE 180-200 LB-IN.
21. AFTERBURNER FUEL DISCHARGE CHECK VALVE (DO NOT REMOVE EXCEPT AT OVERHAUL).

*LOCKWIRE REQUIRED

4C-2-8-(17)A

Figure 6-2. Afterburner Fuel Pump Removal and Installation

c. Use a new gasket and fasten fuel manifold in place. *Torque mounting bolts 80 to 130 inch-pounds and lockwire.*

d. Connect vent tube, seal drain hose, reference pressure hose, torch igniter on-off signal pressure hose, and temperature amplifier cooling flow hose. *Torque and lockwire.*

e. Align CIT sensor capillary tubes along fuel outlet hose and install clamps.

f. *Close door 22 and 81R or 82L.*

6-70. TORCH IGNITER ON-OFF VALVE. See figure 6-3.

6-71. Tools and Equipment.

Wrench, torque, 0 to 200 inch-pounds

6-72. Materials.

Lockwire, MS20995NC32

6-73. Removal.

a. Open door 83 L or R.

b. Disconnect three attaching lines and remove fittings.

c. Remove bolts holding on-off valve to mounting brackets and remove valve.

6-74. Installation.

a. Mount on-off valve to brackets on compressor rear frame flange. *Torque mounting bolts 55 to 70 inch-pounds.*

b. Install fitting and O ring into inlet port. *Torque 155 to 175 inch-pounds.*

c. Install fitting and O ring into outlet port. *Torque 135 to 150 inch-pounds.*

NOTE

If valve has filter union in signal port, install with square end inserted in on—off valve body.

d. Install fitting and O ring into signal port. *Torque 135 to 150 inch-pounds and lockwire.*

e. Connect tube to fitting at signal port. *Torque 135 to 150 inch-pounds and lockwire.*

f. Connect tube to fitting at outlet port. *Torque 135 to 150 inch-pounds and lockwire.*

g. Connect tube to fitting at inlet port. *Torque 180 to 200 inch-pounds and lockwire.*

h. *Close doors 83L or R.*

6-75. AFTERBURNER FUEL CONTROL. See figure 6-4.

6-76. Tools and Equipment.

Wrench, torque, 0 to 200 inch-pounds

6-77. Materials.

Lockwire, MS20995NC32

6-78. Manpower Requirement.

a. Two men required.

6-79. Removal.

WARNING

To prevent injury to personnel, make sure safety struts are installed on door 81L and R actuators.

a. Open doors 22, 81L or R and 82L or R.

b. Visually make sure engine fuel shutoff valve indicator in door 22 reads closed. If valve indicator reads open, perform steps f thru k of paragraph 13-43.

c. Remove afterburner fuel filter from inlet port of control.

d. Remove core and annulus fuel outlet hoses from control.

e. Disconnect compressor discharge pressure (CDP) and reference fuel tubes from control.

f. Loosen conduit nut at microadjust unit.

g. Bend down tab washer from throttle shaft locknut. Loosen locknut about 5 turns and push shaft inward to free sheave.

h. Remove afterburner control mounting bolts.

i. Free control from throttle loop cable and remove control from engine.

6-80. Installation.

a. Assemble a new O ring seal and jam nut on 90 degree elbow fitting and install in reference fuel port of control. Leave finger tight until after tube is connected.

b. Assemble a new metal O ring seal on special union fitting and install in compressor discharge pressure (CDP) port of control. *Torque fitting 135 to 150 inch-pounds.*

c. Install a new tab washer under throttle shaft locknut. Loosen locknut at least 5 turns and push inward to free sheave.

d. Position afterburner fuel control on engine, guiding open end of throttle loop through microadjust unit and cable box and into overtravel tube. *Install bolts and washer; tighten and torque 55 to 70 inch-pounds.*

e. Attach core fuel outlet hose and new seal to control. *Torque bolts 55 to 70 inch-pounds and lockwire.*

f. Attach annulus hose, seal, adapter pad and seal to control. *Torque bolts 55 to 70 inch-pounds.*

g. Connect CDP and reference tubes to control. *Torque tubes 135 to 150 inch-pounds and lockwire.*

h. Attach afterburner fuel filter to inlet port of control. *Torque bolts 55 to 70 inch-pounds and lockwire.*

i. *Secure conduit nut to microadjust unit. Torque nut 10 to 20 inch-pounds and lockwire.*

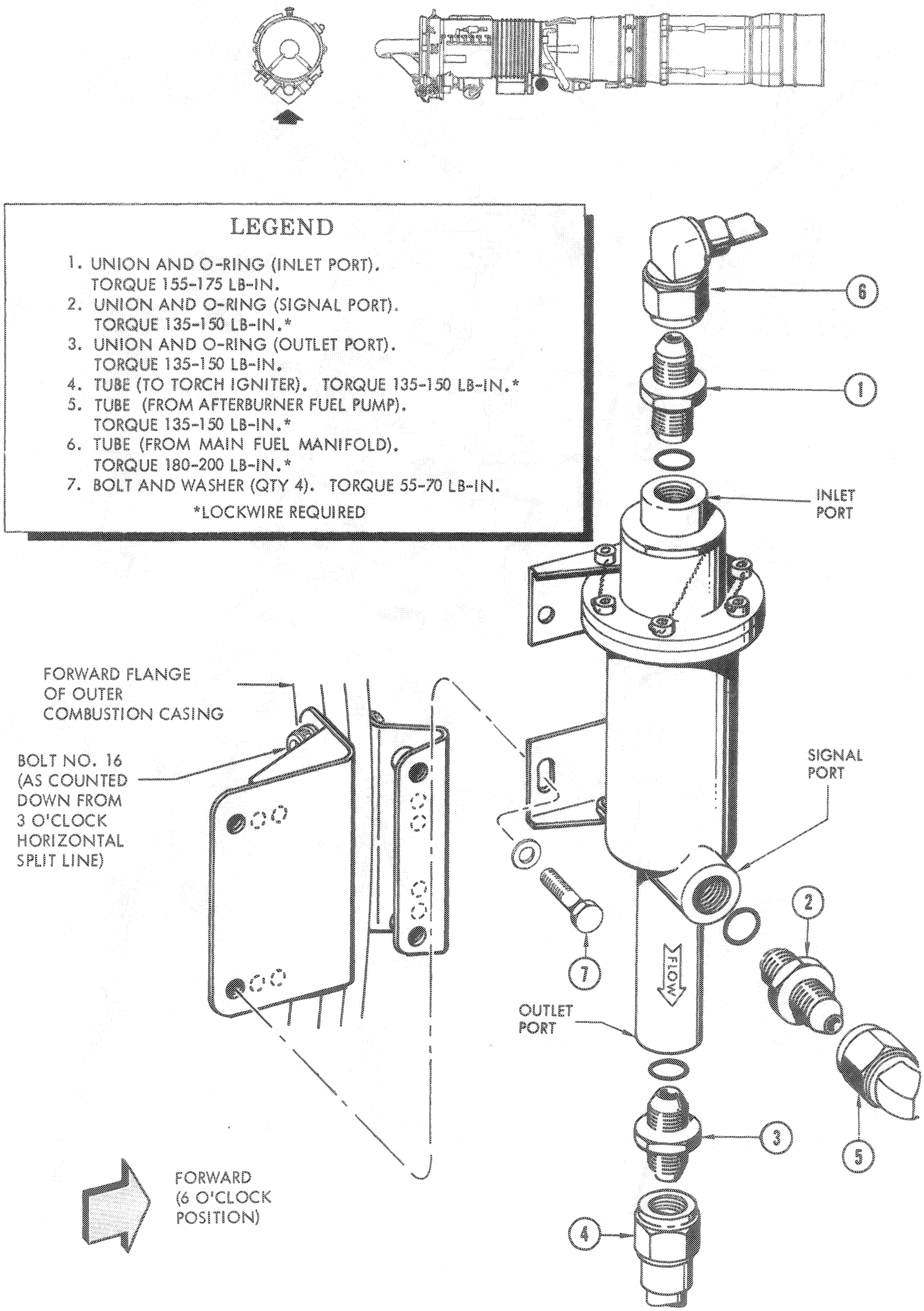


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Figure 6-3. Torch Igniter On-Off Valve Removal and Installation

LEGEND

1. INLET HOSE (FROM AB FUEL PUMP) AND SEAL
2. BOLT, WASHER AND BRACKET. TORQUE 55 - 70 LB - IN. *
3. BOLT AND WASHER (QTY-3). TORQUE 55 - 70 LB - IN. *
4. OUTLET HOSE (TO AB FUEL PRESSURIZING VALVE) AND SEAL.
5. BOLT AND WASHER (QTY-4). TORQUE 55 - 70 LB - IN. *
6. BOLT AND WASHER. TORQUE 55 - 70 LB - IN.
7. INLET TUBE (FROM COMPRESSOR REAR FRAME) TORQUE 135 - 150 LB - IN. *
8. UNION AND SEAL. TORQUE 135 - 150 LB-IN.
9. OVERTRAVEL TUBE (TO CABLE BOX). TORQUE 10 - 20 LB - IN.*
10. MICRO-ADJUST (TO CABLE BOX). TORQUE 50 - 60 LB - IN.* MICRO-ADJUST (TO CONDUIT). TORQUE 60 - 80 LB - IN. *
11. LOCKNUT AND TABWASHER. TORQUE 30 - 40 LB - IN.
12. BOLT AND WASHER (QTY-3). TORQUE 24 - 27 LB - IN.*
13. 90° ELBOW, JAM NUT AND O-RING. TORQUE JAM NUT 135-150 LB-IN.*
14. INLET TUBE (FROM MAIN FUEL PUMP, MAIN FUEL CONTROL AND AB FUEL PUMP). TORQUE 135 - 150 LB - IN. *
15. BOLT, WASHER AND BRACKET. TORQUE 55 - 70 LB - IN.
16. BOLT AND WASHER. TORQUE 55 - 70 LB - IN.
17. BOLT AND WASHER (QTY -4). TORQUE 55 -70 LB IN. *
18. BOLT AND WASHER (QTY - 2). TORQUE 55 - 70 LB - IN.
19. BOLT AND WASHER (QTY -4). TORQUE 55 - 70 LB - IN. *
20. OUTLET HOSE (TO AB OIL COOLER) AND SEAL

* LOCKWIRE REQUIRED

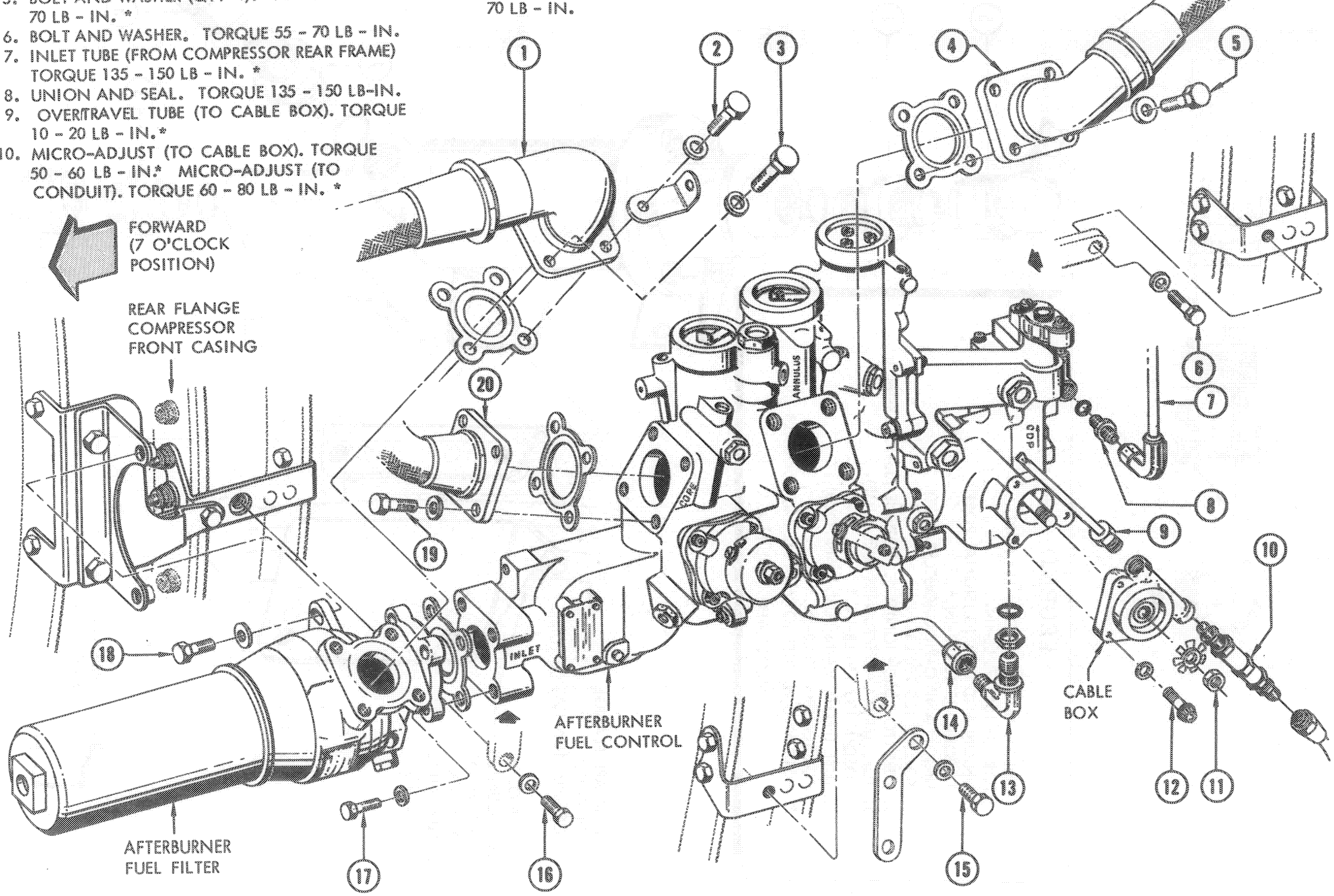

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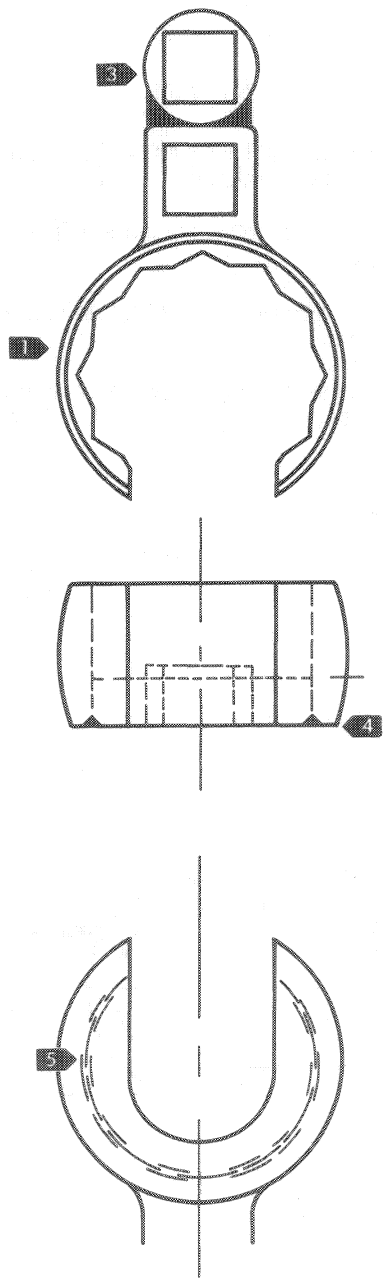
Figure 6-4. Afterburner Fuel Control Removal and Installation



NOTES

1. MAKE FROM BONNEY #AF48 1 1/2 INCH BOX END CROWFOOT.
2. MAKE INSERT FROM 5/16 INCH THICK STOCK.
3. WELD 1/2 INCH SQUARE DRIVE SOCKET TO CROWFOOT AS SHOWN.
4. CUT OFF SOCKET FLUSH WITH CROWFOOT DRIVE LUG AND GRIND SMOOTH.
5. WELD INSERT INTO CROWFOOT AND GRIND SMOOTH.

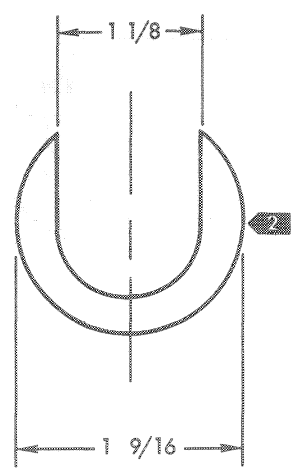


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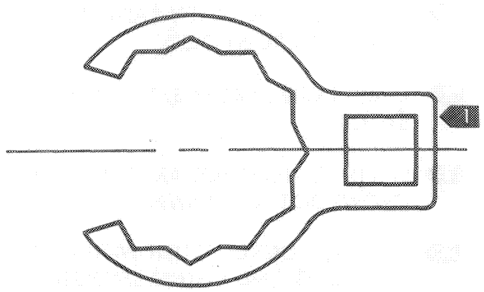
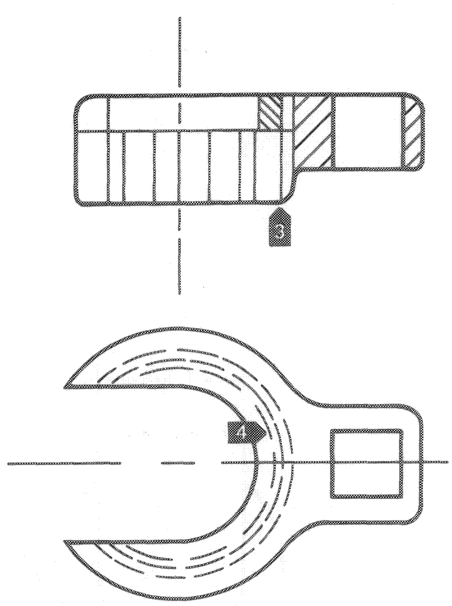
Figure 6-4A. Afterburner Pressurizing Valve Tube Torquing Tools (Sheet 1 of 2)



NOTES

1. MAKE FROM BONNEY #AF44 1 3/8 INCH BOX END CROWFOOT.
2. MAKE INSERT FROM 1/4 INCH THICK STOCK.
3. CUT OFF SOCKET TO 9/16 INCH AND GRIND SMOOTH.
4. WELD INSERT INTO CROWFOOT AND GRIND SMOOTH.



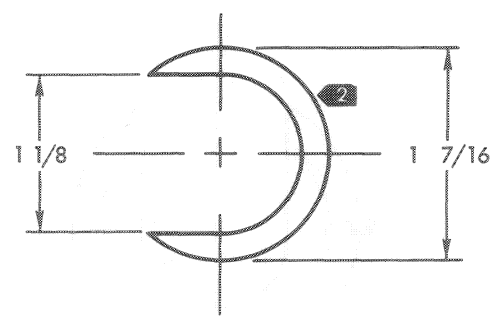


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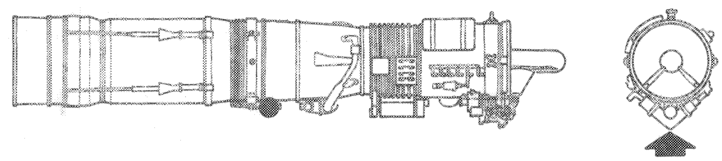
Figure 6-4A. Afterburner Pressurizing Valve Tube Torquing Tools (Sheet 2 of 2)



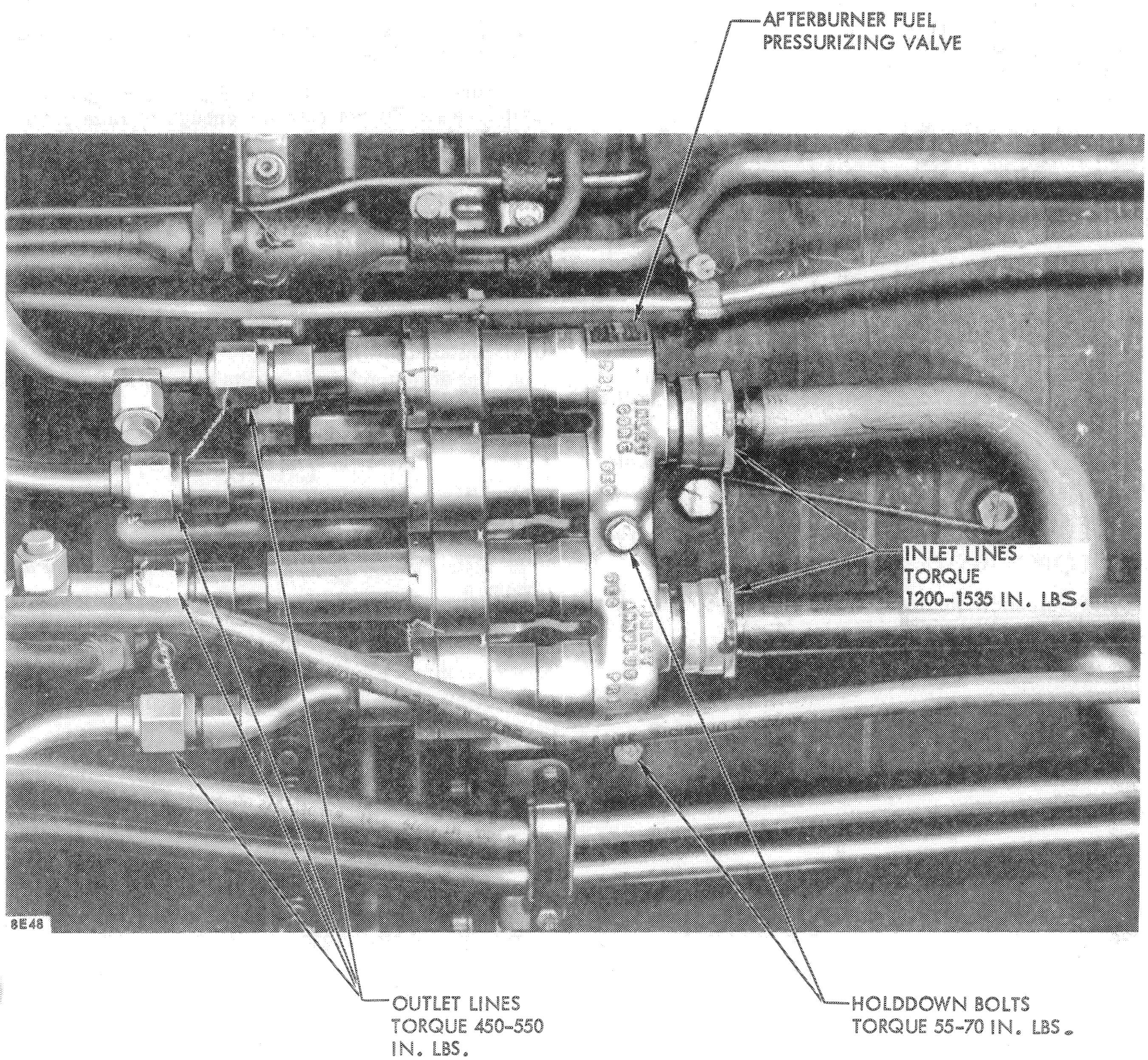


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Figure 6-5. Afterburner Fuel Pressurizing Valve Removal and Installation

j. Rig throttle loop system. Refer to section IV.

k. *Close doors 22, 81L or R and 82L or R.*

6-81. **AFTERBURNER FUEL PRESSURIZING VALVE.** See figures 6-4A and 6-5.

6-82. **Tools and Equipment.**

Wrench, holding, 1C3837P
Wrenches, LM
Wrench, torque, 0 to 100 inch-pounds
Wrench, torque, 0 to 3000 inch-pounds

6-83. **Materials.**

Lockwire, MS20995NC32

6-84. **Removal.**

a. Open door 83 L or R.

b. Cut lockwire and disconnect six attaching lines. Use special wrench to hold valve tubes when loosening inlet tube swivel nuts.

c. Remove two attaching bolts and remove fuel pressurizing valve.

6-85. **Installation.**

a. Install attaching bolts. *Torque bolts 55 to 70 inch-pounds.* Connect outlet lines to valve. *Torque outlet lines 450 to 550 inch-pounds and lockwire.*

b. Using special wrench, hold valve tubes. *Tighten inlet tube swivel nuts, torque 1200 to 1535 inch-pounds.*

c. *Close door 83 L or R.*

6-86. **TORCH IGNITER.** See figure 6-6.

6-87. **Tools and Equipment.**

Wrench, torque, 0 to 200 inch-pounds

6-88. **Materials.**

Lockwire, MS20995NC32
Grease, MIL-L-25681
Milk of magnesia, unflavored

6-89. **Removal.**

a. Open door 92 L or R.

b. Remove clamp holding aft engine drain lines to provide accessibility and clearance when removing torch igniter.

c. Disconnect afterburner spark plug leads at turbine frame connector.

d. Cut lockwire and disconnect fuel inlet tube and compressor discharge tube.

e. Cut lockwire and remove two sets of spraybar manifold tubes.

f. Remove torch igniter attaching bolts.

g. Remove torch igniter and gasket.

6-90. **Assembly.**

a. Insert liner into torch igniter housing so guide seats in housing. Spark plug and fuel nozzle openings must face strut.

b. Install fuel nozzle through gasket and into opening on mounting flange and liner. Nozzle opening must face liner opening.

c. Secure nozzle using 3 bolts, lubricant MIL-L-25681B, and washers. *Torque bolts 24 to 27 inch-pounds and lockwire.*

d. Turn variable seat of spark plug to top of threads.

e. Insert spark plug into torch igniter so control flange seats on liner flange.

f. Turn variable seat downward until it contacts torch igniter flange. Do not turn far enough to raise control flange from liner flange.

g. Assure proper alignment of electrical connector and spark plug lead. *Secure with sleeve nut, finger tight, and inspect installation of plug by looking into liner to see that tip is visible within liner.*

h. *Torque sleeve nut 40 to 50 inch-pounds and lockwire.*

6-91. **Installation.**

a. Lubricate torch igniter bolts with milk of magnesia, install gasket and torch igniter.

b. *Torque bolts 55 to 70 inch-pounds.*

CAUTION

Extreme care must be exercised during installation of spray bars.

c. Install two spray bar manifold tubes. *Torque and lockwire.*

d. Reconnect fuel inlet tube and compressor discharge tube. *Torque and lockwire.*

e. Reconnect afterburner spark plug lead.

f. Relocate engine drain lines and secure with clamps.

g. *Close door 92L or R.*

6-92. **AFTERBURNER FUEL FILTER.** See figure 6-7.

6-93. **Tools and Equipment.**

Wrench, strap, 1 to 5 inch-diameter
Wrench, torque, 0 to 200 inch-pounds

6-94. **Materials.**

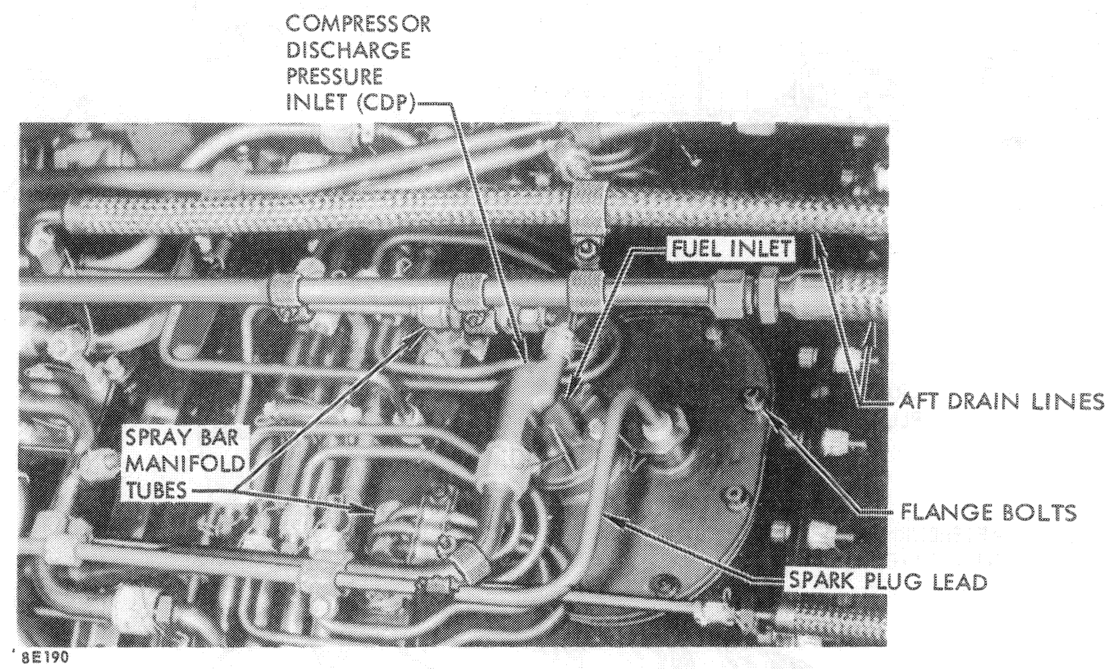
Lockwire, MS20995NC32
Petrolatum, VV-P-236

6-95. **Removal.**

WARNING

To prevent injury to personnel, make sure safety struts are installed on door 81L and R actuators.

a. Open door 22 and 82L or disconnect door 81R actuator.



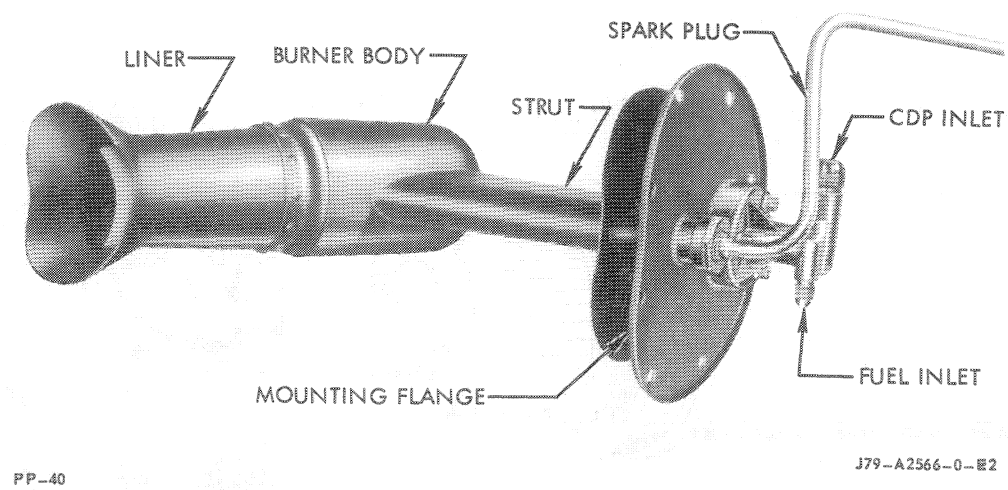


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Figure 6-6. Torch Igniter Removal and Installation

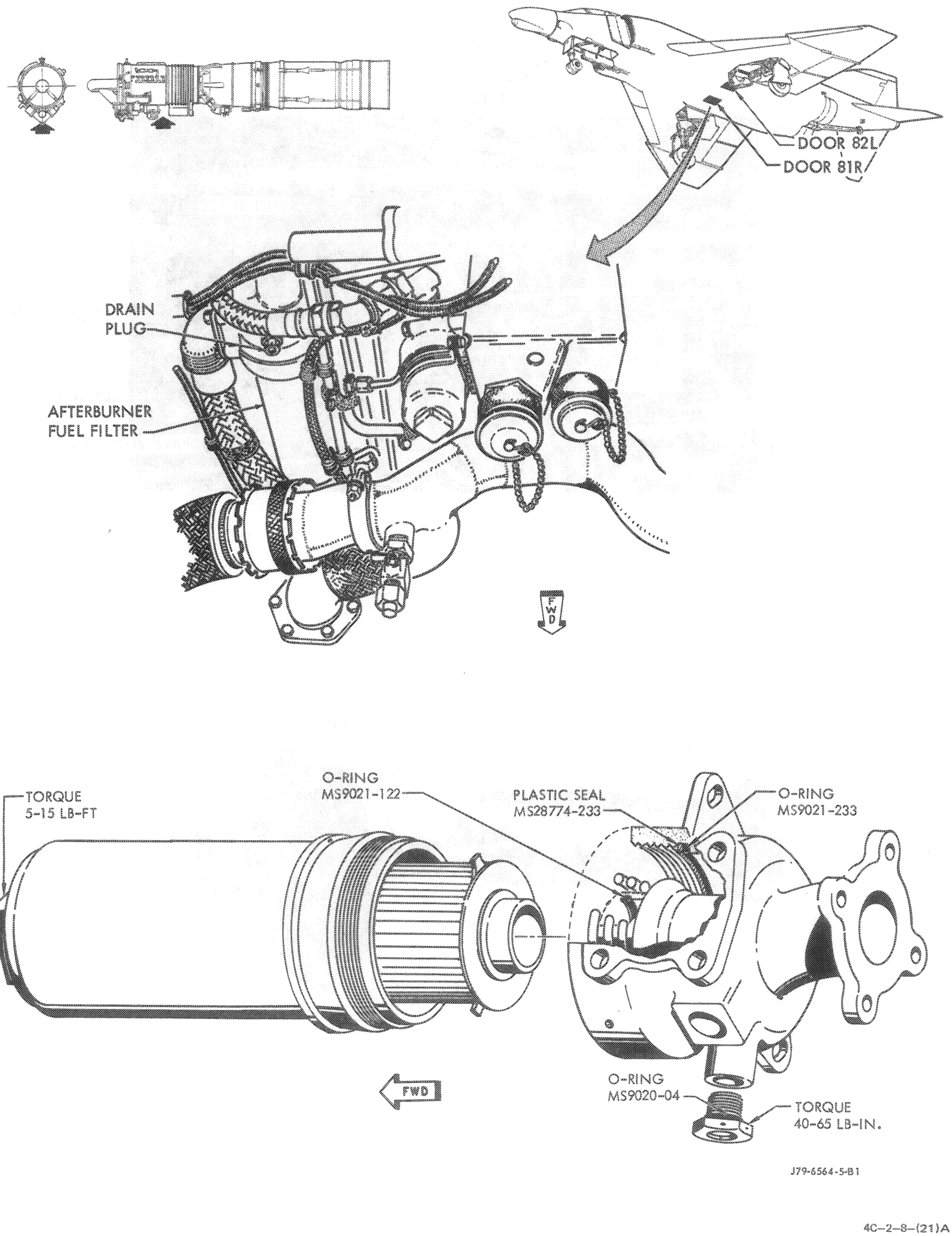

Figure 6-7. Afterburner Fuel Filter Removal and Installation

b. Visually make sure engine fuel shutoff valve indicator in door 22 reads closed. If valve indicator reads open, perform steps f thru k of paragraph 13-43.

c. Remove lockwire and drain plug located in the filter head. Allow fuel to drain into a suitable container.

d. Remove lockwire and filter bowl. Use strap wrench to remove filter bowl on right engine.

e. Remove filter element.

f. Remove the O rings from the drain plug and the inner flange of the filter body and discard.

NOTE

The plastic seal and O ring in the outer flange of the filter body are replaced only if damaged or leaking.

6-96. Installation.

NOTE

Lightly coat O rings with petrolatum during installation.

a. Install new O rings on drain plug and inner flange of filter body. If plastic seal and O ring in filter body were removed install new ones.

b. Install filter element in filter bowl and screw bowl into filter head.

c. *Torque bowl 60 to 180 inch-pounds and secure with lockwire. On right engine torquing can be accomplished in the following manner:*

(1) *Tighten filter bowl hand tight.*

(2) *Use a pencil and make a match mark on filter bowl and filter head.*

(3) *Use strap wrench and tighten filter bowl no more than 1/16 inch. Secure bowl with lockwire.*

d. *Install drain plug in filter head and torque 40 to 65 inch-pounds. Secure with lockwire.*

e. *Close doors 22 and 82L or connect door 81R actuator.*

6-97. CLEANING, DRAINING, AND LUBRICATION.

6-98. AFTERBURNER REFERENCE FUEL FILTER.

See figure 6-8.

6-99. Tools and Equipment.

Ultrasonic cleaning unit
Wrench, torque, 0 to 100 inch-pounds

6-100. Materials.

Solvent, P-D-680, Type II or O-T-634
Lockwire, MS20995NC32
Petrolatum, VV-P-236

6-101. Disassembly.

WARNING

To prevent injury to personnel, make sure safety struts are installed on door 81L and R actuators.

a. Disconnect door 81L actuator or open door 82R.

b. Visually make sure engine fuel shutoff valve indicator in door 22 reads closed. If valve indicator reads open, perform steps f thru k of paragraph 13-43.

c. Disconnect fuel inlet line from filter and remove filter from fitting on pump.

d. Unscrew filter end cap and remove element and spring.

e. Remove O ring and discard.

6-102. Cleaning.

a. Clean filter element and body using cleaning solvent and brush with soft bristles longer than depth of pleats in filter element. A preferred method of cleaning is ultrasonic cleaning if equipment is available. Clean filter for 5 minutes at room temperature using trichlorethylene in cleaning tank and rotate 90 degrees after each minute of cleaning. Backflush if possible.

CAUTION

Air pressure must not exceed 40 psig maximum to prevent filter element damage.

b. Shake or blow excess solvent from filter element.

6-103. Inspection.

a. *Inspect filter element for tears, buckling, obstructions, and residual contamination.*

b. *Inspect seal seating surface for burrs.*

6-104. Assembly.

NOTE

To facilitate installation of O ring, coat lightly with petrolatum.

a. Install filter element and spring into filter body.

b. Assemble filter end cap to filter body.

c. *Torque end cap 20 to 25 inch-pounds and lockwire.*

d. Install filter on pump fitting and connect fuel inlet line. *Torque and lockwire connector nuts.*

e. *Check assembled filter for leaks during next engine operation.*

f. Connect door 81L actuator or close door 82R.

6-105. AFTERBURNER FUEL FILTER.

6-106. Tools and Equipment.

Ultrasonic cleaning unit

6-107. Materials.

Solvent, P-D-680, Type II or O-T-634

6-108. Removal. Refer to paragraph 6-79.

6-109. Cleaning Procedure. (preferred method)

CAUTION

Cover ends of filter element to prevent contaminants from entering filter.

6-110. Clean filter for 5 minutes in ultrasonic cleaning unit. Position element horizontally in cleaning tank and rotate 90° after each minute of cleaning. Back flush if possible.

6-111. Cleaning Procedure. (alternate method)

CAUTION

Cover ends of filter element to prevent contaminants from entering filter.

6-112. Clean element and parts with a soft bristled brush and solvent. Assure bristles are longer than depth of pleats in filter. Shake excess solvent from element.

6-113. Installation.

a. Inspect filter element for tears, buckling, obstructions, and contamination.

b. Inspect sealing surfaces for burrs.

c. Refer to paragraph 6-80 for procedure.

SHOP MAINTENANCE

6-114. MAINTENANCE PROCEDURES.

6-115. This section provides maintenance procedures applicable to components/systems when removed from the aircraft. Table 6-2 lists the functional line replaceable units (LRU) of the system with the location of applicable maintenance procedures. Shop maintenance procedures, when contained in this manual, are referenced by paragraph numbers; when contained in accessory publication, the T O numbers of the applicable manuals are listed. Manuals in the F-4 series or in general aircraft series are listed when containing procedures directly applicable to the LRU. When separate overhaul/illustrated parts breakdown manuals have been provided, the T O numbers are listed.

6-116. **PACKAGING.** Components to be forwarded to the next higher level of maintenance for repairs, test, or check must be cleaned, preserved and packaged for protection against physical and mechanical damage during subsequent handling, shipping and storage. For preservation and packaging methods referred to herein, refer to AFP 71-4 volumes 1 and 2. Components packed for forwarding must further be identified, marked and documented in accordance with applicable Air Force procedures.

Table 6-2. Line Replaceable Units

Line Replaceable Unit	Manufacturers Part Number	Applicable Maintenance Procedures/Publications Shop (Intermediate Level)	Applicable Maintenance Procedures/Publications Overhaul/IPB
Pump, afterburner fuel	512D809		T.O.6J10-4-45-73, -74
Control, afterburner fuel	517D174 517D174		T.O.6J3-2-18-3, -4
Valve, torch igniter on-off	576C370		T.O.6J15-10-181-3
Filter assembly, reference fuel	576C688	Paragraph 6-99	
	576C691		
Igniter, torch	639E611 639E339		
Valve, afterburner fuel pressurizing	868C349 868C349		T.O.6J15-7-47-3, -4
Filter, afterburner fuel	874C867		

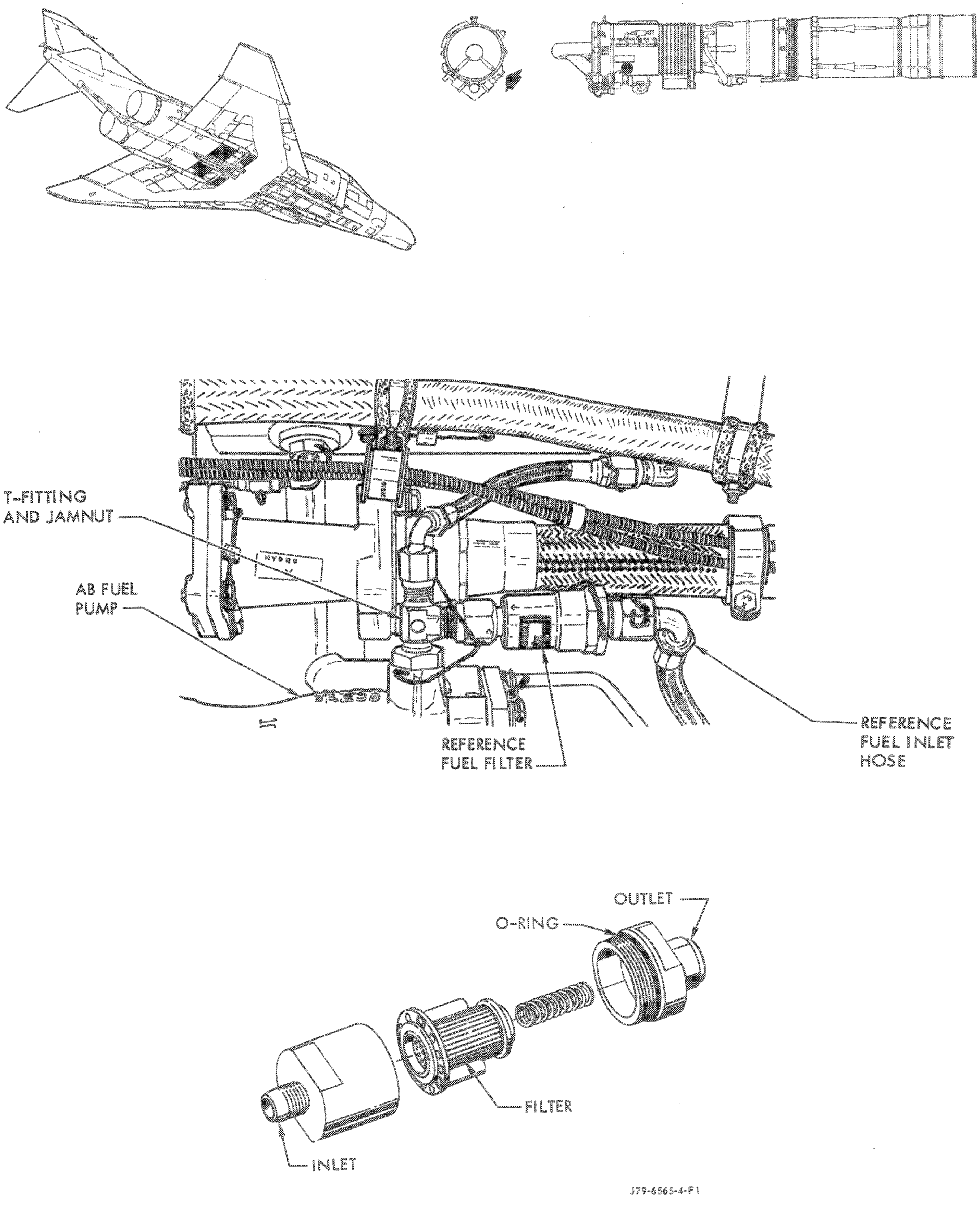

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Figure 6-8. Afterburner Reference Fuel Filter

SECTION VII

VARIABLE EXHAUST NOZZLE SYSTEM

DESCRIPTION

7-1. **SYSTEM.** See figures 7-1 and 7-2.

7-2. The variable exhaust nozzle system provides a means for controlling thrust and protecting the turbine section from overtemperature by varying the nozzle area. To control nozzle area the variable nozzle system embodies two subsystems: the nozzle actuation subsystem, and the temperature limiting subsystem. The nozzle actuation subsystem schedules and positions the exhaust nozzle assembly. The temperature limiting subsystem precludes engine overtemperature or performance loss by overriding the schedule of the actuation subsystem.

7-3. **COMPONENTS.**

7-4. **NOZZLE ACTUATION SUBSYSTEM.**

a. Nozzle area control

b. Nozzle pump

c. Hydraulic supply pump and filter

d. Nozzle-pump-inlet relief valve

e. Nozzle hydraulic filters

f. Nozzle actuators

g. Exhaust nozzle

7-5. **TEMPERATURE LIMITING SUBSYSTEM.**

a. Temperature amplifier

b. Thermocouple harness

c. Control alternator

7-6. **Nozzle Area Control.** See figure 7-1. The nozzle area control which is at the 8 o'clock position on the compressor rear casing, schedules nozzle area by controlling the output of the nozzle pump.

7-7. Mechanical and electrical signals are supplied to the nozzle area control. The control schedules nozzle area as a function of throttle position (mechanical) except as overridden by the temperature amplifier according to the T5 vs. N schedule. During this condition the control receives an electrical signal from the temperature amplifier. This signal actuates the internal mechanism of the control so the nozzle is scheduled to permit rapid engine acceleration on a throttle burst, and to control exhaust gas temperature while at stabilized speeds above 79 percent and in the afterburner range. Nozzle feedback returns the mechanism of the control to the null position when the nozzle reaches the scheduled area. The output rod of the control is connected to the control lever of the nozzle pump. Regulated servo fuel, from the main fuel control, is used as working pressure inside the nozzle area control. Excess fuel in the control is returned to boost reference. The electrical connector on the control contains wiring for both the torque motor signal from the temperature amplifier and the nozzle area signal to the cockpit.

7-8. **Nozzle Pump.** The nozzle pump develops a high pressure output that supplies the head and rod end ports of the nozzle actuators. The differential pressure across the pistons of the actuators moves the pistons and rods to actuate the nozzle flaps.

7-9. The nozzle pump is a variable displacement, reversible flow, piston pump. It is on the left rear pad of the rear gearbox. On the rear of the pump is a bracket for mounting the nozzle hydraulic filters. See figure 7-1 for design features of the nozzle pump.

7-10. **Nozzle Actuators.** The nozzle actuators position the flaps of the variable nozzle. The four nozzle actuators are double acting, uncushioned hydraulic cylinders. Oil acts as both a lubricant and hydraulic fluid. Movement of the four actuator pistons is synchronized through flexible torque shafts. These flexible shafts rotate within the head end tubes connecting the actuators. The actuators are attached to a rib near the front of the rear exhaust duct. The rods are attached to the nozzle support ring and move it axially with respect to the tailpipe. Extending the actuators opens the nozzle flaps. See figure 7-1 for design features of the nozzle actuators.

7-11. **Hydraulic Supply Pump and Filter.** The hydraulic filter removes contaminant from the oil that is used in the nozzle system. The lube element and the hydraulic element are housed in a single body; however, each filter is independent of the other and has its own flow path, relief valve, check valve, shutoff valve, filter element and filter bowl. The filter body is attached to the lube and hydraulic pump, which is mounted on the rear face of the rear gearbox. Refer to section VIII for description of the lube and hydraulic pump. See figure 7-1 for design features of the hydraulic filter element.

7-12. **Nozzle Pump Inlet Pressure Relief Valve.** See figure 7-1. The hydraulic pressure relief valve limits the oil pressure in the nozzle pump cavity when the nozzle is closing and the oil is being returned from the actuators. The valve is a high pressure-drop, poppet type check valve. It is connected to the outlet fitting of the rear gearbox scavenge pump.

7-13. **Nozzle Hydraulic Filters.** The nozzle hydraulic filters (bi-directional filters) prevent contaminant from circulating throughout the nozzle system. Contaminant is isolated by the filters to the part of the system in which it originated. The filters are installed in the head and rod end nozzle actuator lines. The filters are on the rear of the nozzle pump. Each filter incorporates a belvalve type relief valve. See figure 7-1 for design features of the nozzle hydraulic filters.

7-14. **Temperature Amplifier.** See figure 7-1. The temperature amplifier transmits an output signal to the nozzle area control torque motor. This signal acts to regulate exhaust nozzle area as a function of exhaust gas temperature, engine speed, rate of change of exhaust gas temperature and rate of change of engine speed.

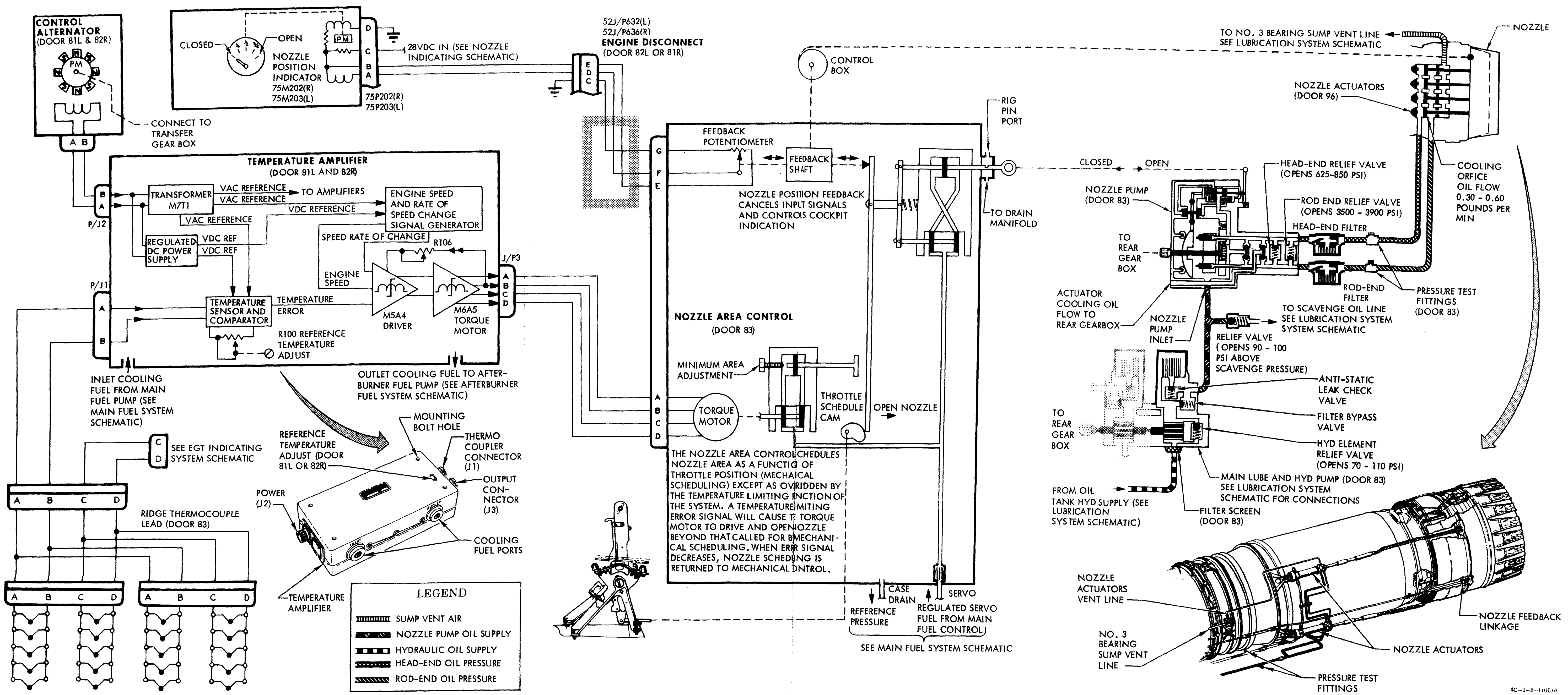


Figure 7-1. Variable Nozzle System Schematic

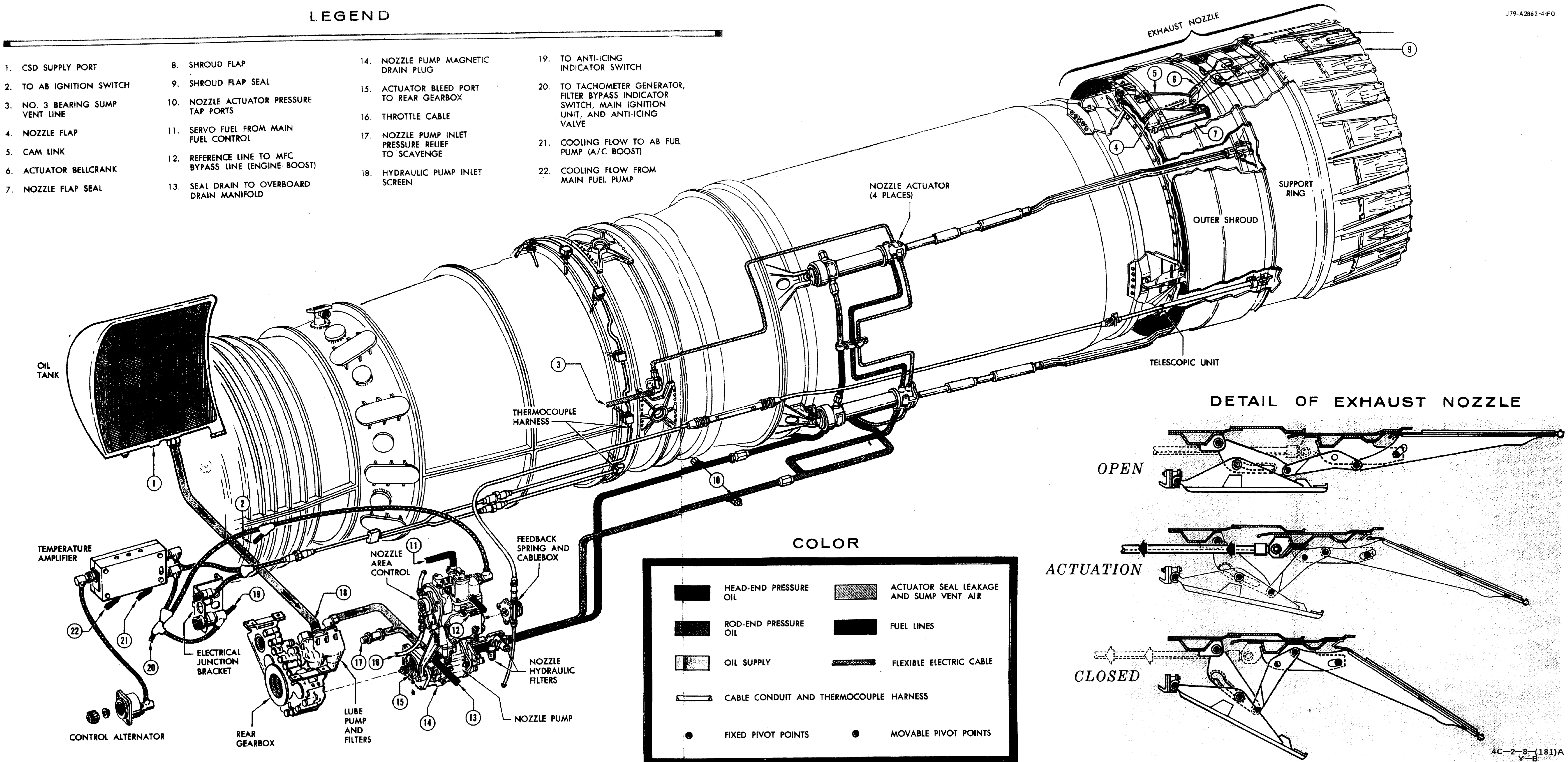


Figure 7—2. Variable Nozzle System

7-15. The temperature amplifier is at the 8 o'clock position on the compressor front casing. During engine operation fuel flows through a manifold on the underside of the amplifier to cool the internal components. Fuel flows through this manifold from the main fuel pump at 325 pph with a pressure differential of 25 $\pm$15 psi between the fuel inlet and outlet ports. The fuel is returned to the afterburner fuel pump inlet. See table 7-1 for design features of the temperature amplifier.

Table 7-1. Leading Particulars

Leading Particulars	Specifications
NOZZLE PUMP	
Shaft shear section	1000 to 1500 lb-in. torque
Actuator bleed	0.60 to 0.75 gpm
Head end relief valve	625 to 850 psi
Rod end relief valve	3500 to 3900 psi
Control servo pressure	230 to 300 psi above inlet pressure
Rated speed	4152 rpm at 7685 rpm engine speed
NOZZLE ACTUATORS	
Combined cooling orifice and piston seal leakage	0.45 $\pm$.15 pounds per minute at oil temperature of 100°F and a 300 psi differential pressure
Rod seal leakage (only external leakage permitted)	1 cc per hour
Rated pressure	300 psi rod end pressure 500 psi head end pressure
HYDRAULIC FILTER ELEMENT	
Check valve	Opens at 6 psi inlet oil pressure
Relief valve	Opens at 35 psi differential pressure
Filter element	46 micron
Pressure drop (clean element)	19 psi at 3.9 pph flow with oil at 100°F
NOZZLE HYDRAULIC FILTERS	
Filter element	40 micron
Rated flow capacity	2 gpm
Relief valve cracking pressure	22 psi min. in both directions
TEMPERATURE AMPLIFIER	
Power input from control alternator	50 vac at 829 cps at 100 percent engine speed
Normal reference temperature setting	625°C at 100 percent engine speed

7-16. **Thermocouple Harness.** See figure 7-1. The thermocouples convert heat energy from the engine exhaust gases into electrical signals which are used to indicate and control the engine operating temperature. The harness consists of two half sections. Each section contains six probe assemblies connected by formed, rigid piping. A probe assembly comprises a junction box, a harness mounting nut and flange, two loop junction thermocouples, insulation and a housing to support the thermocouples and thermocouple wiring, and a cylindrical shield to protect the thermocouples. One leg of the thermocouple wiring is chromel (non-magnetic) wire and the other leg is alumel (magnetic) wire. A loop junction thermocouple is fabricated by welding together two small loops of these dissimilar metals. The assembled half sections make up two independent thermocouple circuits, with each circuit consisting of 12 thermocouples connected in parallel. The harness is mounted on the turbine frame so that the probes extend into the exhaust gas flow slightly downstream from the no. 3 turbine wheel.

7-17. **Control Alternator.** The control alternator generates the electrical power that is supplied to the temperature amplifier. The alternator is a single phase ac generator with an 8 pole, permanent magnet rotor. The drive shaft is provided as part of the gearbox; therefore, the control alternator has no bearing and requires no lubrication. The stator winding is potted to protect the winding if oil leaks across the drive shaft seal.

OPERATION

7-18. **GENERAL.** See figure 7-2.

7-19. The throttle cable rotates a schedule cam in the nozzle area control. A feedback cable, which is attached to the exhaust nozzle assembly, transmits the nozzle position to the nozzle area control. The difference between the schedule cam and nozzle position produces a movement of an output piston and rod in the direction and magnitude as directed by this difference. The output rod of the nozzle area control is connected to and moves the control lever of the nozzle pump. The nozzle pump, which is able to produce a high-pressure hydraulic supply to either end of the nozzle actuators in response to the nozzle area control signal, causes the actuators to move the nozzle. As the nozzle moves, the feedback cable nullifies the difference between the schedule cam and the nozzle position in the nozzle area control, and consequently, the control removes the output rod signal from the control lever of the nozzle pump. The pump in turn ceases to supply the unequal hydraulic pressure to the actuators. The pump then maintains differential pressure to the actuators to hold them at the desired position.

7-20. To preserve engine performance and yet obtain thrust modulation within safe operating temperatures, the temperature limiting subsystem is able to increase the nozzle area farther than the scheduled area. Temperature limiting becomes effective at speeds as low as 79 percent engine speed at sea level static operation but varies with changes in altitude and ambient temperature. During engine speed and temperature transients other limits are imposed on the scheduled nozzle area to restrict temperature peaks with a minimum sacrifice of the rate of thrust change, such as AB light-offs and rapid accelerations. At engine speeds above 98 percent, the temperature limiting system overrides the mechanical schedule in order to maintain a maximum turbine discharge temperature (EGT) of 625°C.

7-21. The exhaust nozzle consists of two sets of flaps and seals. The inner, or primary nozzle regulates engine air pressures and temperatures. The primary nozzle accelerates the exhaust gases to the throat, or smallest area. The other, or secondary nozzle directs secondary air, which flows along the outside of the engine, to form a divergent nozzle around the exhaust gases. This aerodynamic nozzle produces an additional velocity increase, when the exhaust gases in the throat of the primary nozzle is at a maximum (the speed of sound within the gases). The exhaust nozzle is so constructed that displacement of the support ring toward the gear of the engine simultaneously increases the area of the primary nozzle throat, the angle of the secondary nozzle divergence, and the spacing distance between the primary throat and the impingement of secondary air.

7-22. A potentiometer on the nozzle feedback shaft of the nozzle area control transmits a signal voltage representing nozzle area to the nozzle position indicator in the cockpit.

7-23. **COMPONENTS.**

7-24. **NOZZLE AREA CONTROL.** See figure 7-1. The throttle flexible cable rotates the throttle schedule cam in the nozzle area control. The follower arm roller, riding in the groove cut in the schedule cam, moves the follower arm which positions the sector gear for mechanical scheduling of the nozzle. The overtemperature follower arm, the sector gear, and the spiral spring on the end of the cam follower shaft are pinned to the shaft. The schedule cam follower arm turns on the cam follower shaft, but is connected to the spiral spring by a pin. Movement of the schedule cam to rotate the sector gear in a counterclockwise direction (open nozzle) is transmitted directly by the follower arm: movement in a clockwise direction (close nozzle) is transmitted through the spiral spring. The overtemperature piston moving its follower arm downward causes the cam follower shaft and the sector gear to rotate in a counterclockwise direction. This movement of the sector gear does not shift the schedule cam follower arm, as it is held stationary by the groove in the schedule cam and can turn on the cam follower shaft. Rotation of the cam follower shaft winds the spiral spring, and when the temperature limiting condition ceases, the sector gear is returned to the mechanical schedule by spring force.

7-25. The sector gear rotates the left bevel gear of the differential. The feedback cable transmits variable nozzle position to the nozzle area control by turning the sheave and feedback shaft. The feedback shaft operates the right bevel gear of the differential. A difference in amount or direction of rotation of either side bevel gear causes the center bevel gear to turn about the axis of the right and left bevel gears. Movement of the center bevel gear rotates the error cam. The roller riding in the error cam positions the output pilot valve to port servo pressure to the output piston. As the output piston moves, it nulls the output pilot valve by means of the connecting link. The output piston and rod signals the nozzle pump to reposition the nozzle.

7-26. As the nozzle moves, the feedback cable directs the center bevel gear and error cam to move the output pilot valve. Servo pressure is ported to the output piston and repositions the output piston and rod. The output piston again returns the output pilot valve to the null position. When the output pilot valve reaches null, the output rod is scheduling the nozzle pump to maintain an output which holds the nozzle at the desired area.

7-27. When changes in the exhaust gas temperature at any engine speed exceed the scheduled limit, the temperature amplifier transmits an electrical signal to the torque motor to open the nozzle. Movement of the torque motor armature pushes the temperature pilot valve up to port servo pressure to the top of the overtemperature piston. The overtemperature piston moves down and rotates the sector gear counterclockwise. Counterclockwise rotation of the sector gear results in the nozzle moving to the open position.

7-28. During a throttle burst, the nozzle follows mechanical schedule until engine speed increases to approximately 79 percent. At engine speeds higher than 79 percent, an electrical signal from the temperature amplifier to the torque motor directs the nozzle to open on a schedule that is determined by EGT and engine speed. This nozzle schedule permits the engine to accelerate rapidly.

7-29. Another circuit in the temperature amplifier alters the electrical signal transmitted to the torque motor during an AB light. This signal increases the intensity of the nozzle open signal, reducing the rpm roll back which accompanies the AB light.

7-30. **NOZZLE PUMP.** See figure 7-1. The drive shaft of the nozzle pump rotates the piston block assembly and the gear control pump.

7-31. Oil from the hydraulic filter enters the nozzle pump case through the replenishing port. This oil is supplied to the pump pistons and to the control pump. The control pump furnishes servo pressure oil to the control valve. The control lever, which is mechanically connected to the output rod of the nozzle area control, causes the control valve to port servo pressure oil to one side of the stroke control piston and vent the other side to case pressure.

7-32. As the stroke control piston moves, it moves the two links that are connected to it. The upper link moves the followup bushing to cut off the servo pressure oil as the stroke control piston reaches the desired position. The lower link tilts the thrust plate to change the stroke of the pump pistons.

7-33. Tilting the thrust plate counterclockwise produces a high pressure in the head end line. This high pressure oil forces the replenishing valve and the actuator bleed valve to the right. With the replenishing valve in this position, oil from the pump case is supplied to the rod end of the piston block assembly. The actuator bleed valve allows oil to bleed from the system and flow into the rear gearbox through passage A in the pump. This bleed flow provides constant removal of oil from the nozzle system to prevent the oil from becoming overheated. Tilting the thrust plate clockwise gives a similar sequence with the high pressure output of the pump going to the rod end instead of the head end.

7-34. As the variable nozzle reaches the desired area, the nozzle area control repositions the control lever of the pump. This causes the control valve to move, porting oil to the opposite side of the stroke control piston. The stroke control piston returns the thrust plate to a position that produces a pump output sufficient to maintain a differential pressure across the nozzle actuator pistons. This differential pressure holds the nozzle at the desired opening and terminates further pump action until a change in nozzle position is required.

7-35. **NOZZLE ACTUATORS.** Nozzle pump output is piped to the head and rod end ports of the actuators and develops a differential pressure across the pistons to actuate the nozzle flaps. The differential pressure also produces a flow through an orifice in the piston to reduce the temperature of the oil in the actuators.

7-36. The pistons, moving axially in the cylinders, rotate the spiral shafts and the synchronizing gears. Rotation of the gears turns the flexible shafts which synchronize the position of the actuator pistons. Leakage across the rod end seals of the actuators flows through the drain port to the sump vent line.

7-37. **HYDRAULIC SUPPLY PUMP AND FILTER.** Oil from the hydraulic element of the lube and hydraulic pump flows through the inlet port to the corrugated filter element. The filter element removes contaminant as the oil passes through. The oil then flows through the holes in the metal core and forces the check valve open to reach the outlet. The relief valve opens to bypass unfiltered oil to the outlet if the filter element becomes clogged to the extent that the pressure differential across the valve reaches 35 psi. The shutoff valve closes when the filter bowl and element are removed to prevent oil loss from the oil tank.

7-38. **NOZZLE PUMP INLET PRESSURE RELIEF VALVE.** The pressure relief valve opens to port the hydraulic oil to the scavenge oil system when the replenishing oil pressure in the nozzle pump reaches 95 ± 5 psi above scavenge oil pressure. Also the pressure relief valve releases excessive nozzle pump case pressure when the nozzle actuators are retracting (closing the nozzle).

7-39. **NOZZLE HYDRAULIC FILTERS.** See figure 7-1. The nozzle hydraulic filters (belvalve type) permit oil to flow in both directions. Differential oil pressure between the two ports determines the direction of flow through the filters. Normal flow through the filter element is depicted in figure 7-1. However, when the filter element becomes clogged enough to cause a pressure differential of 22 psi or higher, the relief valve opens and bypasses unfiltered oil. Operation of the relief valve is basically the same for flow in either direction. When the direction of oil flow is as shown in figure 7-1, the relief valve functions in the following manner; oil pressure, acting on the side and bottom of the belvalve washer, forces the washer to deflect upward, permitting the oil to flow through the belvalve housing and the opening in the belvalve cage to the outlet port. Oil flow in the opposite direction takes the same path with the exception that it exerts downward pressure on the top of the belvalve washer, forcing it to deflect downward.

7-40. **TEMPERATURE AMPLIFIER.** See figure 7-1. The temperature amplifier is at the 8 o'clock position on the compressor front casing. During engine operation fuel flows through a manifold, on the underside of the amplifier to cool the internal components.

7-41. The only external adjustment on the amplifier is the reference temperature (T5). The reference temperature can be adjusted with a hex head wrench, the adjustment range is as follows:

a. 25 turns, full range of adjustment.

b. 6 clicks, per turn (cw to increase).

c. .72°C per click.

d. 4.32°C per turn.

e. 590°C to 663°C normal range.

7-42. The amplifier has three external electrical connections. The upper rear, or J1 connector, receives the thermocouple temperature millivolt signal from the thermocouple harness. The forward, or J2 connector, receives the power input from the control alternator. The lower-rear, or J3 connector, sends the amplifier output signal to the nozzle area control torque motor.

7-43. Internally the amplifier consists of individually potted modules containing the various amplifier circuits. This method of construction eliminates the need for special shock mounting and facilitates troubleshooting and parts replacement.

7-44. The temperature amplifier receives the thermocouple millivolt signal through connector J1, compares this signal with the preset reference millivolt signal produced by the thermocouple reference module, amplifies and modifies the resulting signal within the driver and derivative amplifiers, and sends the resulting signal to the nozzle area control torque motor. This signal is the amplifier output signal.

7-45. If the output signal to the torque motor represents an engine over-temperature control (exhaust gas temperature exceeding 625°C) the torque motor affects the nozzle area control so that an open nozzle output signal is called for. If the output signal to the torque motor represents an engine under-temperature condition (exhaust gas temperature below 625°C) the torque motor provides a closed nozzle signal to the nozzle area control. Since the mechanical schedule represents the minimum nozzle area, the temperature amplifier is only an over-temperature correction device. Under-temperature conditions are regulated by the nozzle mechanical schedule.

7-46. The amplifier output signal is a product of the components contained within seven modules inside the amplifier. The modules are:

a. Thermocouple reference (M1)

b. Temperature error amplifier (M2)

c. Derivative and driver amplifier (M5)

d. Torque motor amplifier (M6)

e. Speed signal generator (M4)

f. Transformer (M7)

g. Filter (M3)

7-47. **THERMOCOUPLE REFERENCE MODULE.** The thermocouple reference module uses a dc power supply, received from the transformer module, to produce a preset reference temperature signal millivoltage. The reference signal millivoltage, as governed by a variable resistor, represents the desired engine exhaust gas temperature at military, 625°C. This reference signal is then compared with the engine exhaust gas temperature millivolt signal. A resistor within the module compensates for ambient temperature changes around the thermocouples cold (or reference) junction.

7-48. The difference between the reference temperature millivoltage and the engine exhaust gas temperature millivoltage is called the temperature error signal. The polarity and strength of the error signal is determined by the amount and direction of temperature signal difference (engine over-temperature or under-temperature). The error signal is sent to the temperature error amplifier module.

7-49. **TEMPERATURE ERROR AMPLIFIER MODULE.** The temperature error amplifier module contains two amplifiers, in series, which amplify the error signal. A portion of the final output of the module is routed back to the input side as feedback; this cuts system gain and increases module stability. The amplified error signal is sent to the derivative and driver amplifier module.

7-50. **DERIVATIVE AND DRIVER AMPLIFIER MODULE.** The module contains two amplifiers, a derivative amplifier and a driver amplifier. The derivative amplifier receives two input signals, the amplified error signal from the temperature error amplifier and the engine speed signal from the speed signal generator.

7-51. A temperature lead function of the derivative amplifier compensates for the lag in the thermocouples between an actual exhaust gas temperature rise and the indication of this rise at the reference junction of the thermocouple. This lag in indicated thermocouple temperature causes the error signal to be lower (or higher) during temperature increases (or decreases) than it actually should be. The temperature lead function adds to an increasing temperature error signal and subtracts from a decreasing temperature signal. The effect of the temperature lead function is greatest during rapid temperature changes. As the temperature changes become less rapid the effect of the temperature lead function is reduced until it has little or no effect during gradual transient exhaust gas temperature conditions. The temperature lead function makes the error signal more representative of actual engine temperature conditions and enables the nozzle to react quickly to transient exhaust gas temperatures.

7-52. The engine speed signal which varies inversely with control alternator RPM and therefore, engine speed, decreases gradually as engine speed increases but, it is existent through all engine speed. Within the derivative amplifier the speed signal opposes the error signal, as modified by the temperature lead function. In effect the speed signal subtracts from any error signal that is received by the derivative amplifier.

7-53. A portion of the derivative amplifier output is reversed in polarity and fed back to the input of the derivative amplifier. This feedback cancels derivative amplifier output during non-transient conditions; thus, the derivative amplifier has an output only when it has a changing input, that is, during transient engine speed or exhaust gas temperature conditions. A 0.9 second delay is built into the derivative amplifier feedback system so that 0.9 second elapses from the time the signals enter the amplifier until the signal, as modified, appears in the feedback line. This is the reason that there is no output of the derivative amplifier during steady state conditions since the output is the same as the input and they cancel one another. During transient conditions (input changes every 0.9 sec or faster) the feedback cannot cancel the entire input signal and an output signal from the derivative amplifier results.

7-54. This output signal is the speed derivative signal and it represents the change in engine speed as modified by the temperature error signal. The signal is the result of modifications to the error signal caused by rapidly rising (or falling) exhaust gas temperature or engine speed conditions. The speed derivative signal sends a stronger closed nozzle signal when engine speed is accelerating and a stronger open nozzle signal when the engine is

decelerating. This gives the amplifier the following advantages:

(1) Less engine roll-back on afterburner light-off.

(2) Faster recovery time when coming out of afterburner.

7-55. The derivative amplifier supplies its output, if any, to the driver amplifier. The driver amplifier has an output for all inputs, in transient or steady state conditions.

7-56. The driver amplifier receives three input signals; the temperature error signal from the temperature error amplifier, the modified error signal from the derivative amplifier (composed of transient temperature and engine speed conditions) and the static engine speed signal from the speed signal generator. The driver amplifier combines these three signals and produces a composite output signal which is sent to the torque motor amplifier.

7-57. The error signal from the temperature error amplifier is combined with the output signal of the derivative amplifier within the driver amplifier. The speed signal generator provides a static positive polarity bias to the driver amplifier and its magnitude is proportional to engine speed. This bias is applied against the error signal received from the temperature error amplifier. Comparison of these two signals forms the T5 vs. N function. Above 98% engine speed the speed signal to the driver amplifier decays and is non-existent; however, the speed signal is maintained to the derivative stage for transient engine speed correction.

7-58. The T5 vs. N function gives the effect of resetting the reference temperature according to engine speed rather than being held at a constant 625°C. This enables the engine to make faster accelerations, especially during T2 cutback. It improves acceleration and stall characteristics for cold day operation, and since it is cold at altitude, T5 vs. N improves acceleration at altitude.

7-59. The effective reference temperature as reset by the T5 vs. N function is in section II. Without the T5 vs. N function the nominal line in the figure would remain at 625°C for all engine speeds. The effective resetting of the reference temperature is caused by the addition of the speed signal to the thermocouple error signal. As an example, at 95% engine speed, the speed signal adds a voltage to the error signal corresponding to 14°C. For all temperature error signals closer than 14°C to the reference temperature of 625°C this addition would result in an over-temperature signal, even though the actual error signal is below 625°C. This addition to the error signal can be stated as a subtraction from the reference temperature or as giving the appearance of resetting the reference temperature lower. For engine speeds to 98% the reset reference temperature follows the curve in section II. Above 98% there is no speed signal to the driver amplifier and, therefore, the reference temperature remains at 625°C.

7-60. The effective reference temperature, because of the T5 vs. N function is proportional to engine speed rather than constant. During an acceleration this causes temperature limiting to begin modulating the nozzle at a lower exhaust gas temperature. This results in quicker engine acceleration by maintaining the nozzle in the best acceleration position. This does not impair the stabilizing effect of the derivative amplifier during throttle bursts to military and to afterburner.

7-61. The output of the driver amplifier is sent to the torque motor amplifier. This output signal is the result of modification of the error signal by the temperature lead and speed change functions and the T5 vs. N function.

7-62. **TORQUE MOTOR AMPLIFIER MODULE.** The torque motor amplifier receives the modified error signal, amplifies it and sends it through connector J3 to the nozzle area control torque motor. The polarity and strength of the output signal of the torque motor amplifier determines the direction and amount of travel by the torque motor output controlled temperature pilot valve within the nozzle area control.

7-63. **SPEED SIGNAL GENERATOR MODULE.** The speed signal generator receives an ac signal from the control alternator whose output frequency is proportional to engine speed. The signal is routed through a dual choke, which allows a current, inversely proportional to the frequency, to pass through it. This signal is then amplified and sent to the derivative and the driver amplifiers where it is used as previously discussed. The action of the choke explains the decrease in the speed signal as engine speed increases. For the same reason the signal increases as engine speed decreases. The speed signal to the driver amplifier is always positive due to the action of a blocking diode.

7-64. The module is designed so that the declining speed signal and the preset-constant voltage dc bias are equal when 98% engine speed is reached. Therefore, at 98% engine speed, the speed signal is cancelled and above 98% it is reversed in polarity (the dc bias is greater than the speed signal). When the polarity is reversed the blocking diode in the line to the driver amplifier prevents any speed signal from passing on to the driver amplifier. This accounts for the elimination of the speed signal to the driver amplifier at engine speeds above 98%. The speed signal to the derivative amplifier does not decay at 98% engine speed, but, it does reverse in polarity.

7-65. **TRANSFORMER MODULE.** The transformer receives the control alternator output and steps the voltage down, in five secondary windings, to an amount usable by the temperature amplifier modules. The modules are designed to operate normally with the varying power input. A signal is also sent by the transformer to the filter module for modification for use by the speed signal generator. Another signal is rectified and sent to the dc filter module. This power is then transmitted to the thermocouple reference module.

7-66. **FILTER MODULE.** The filter smooths the rough rpm signal received from the transformer before it is sent to the speed signal generator module. The filter also smooths the dc power signal which is used to set up an accurate reference temperature signal.

7-67. Theory of Operation. During a throttle burst to military setting, the engine goes on an accel schedule, injecting a high fuel flow. This fuel flow causes the exhaust gas temperature to increase. The rising exhaust gas temperature may produce an over-temperature error signal. The error signal is opposed by the speed signal, therefore, the output signal of the derivative amplifier calls for a closed nozzle, this will retard engine acceleration. But, at the same time the T5 vs. N function acts to oppose this closed nozzle signal by adding to the error signal thus producing a greater overtemperature error signal. This creates an open nozzle signal which

overcomes the closed nozzle signal produced by the derivative amplifier. As a result the nozzle opens and engine acceleration is not retarded. The interaction of the error signal, the temperature lead function, the speed derivative function and the T5 vs. N function enables the temperature amplifier to modulate the nozzle as required to maintain adequate thrust with safe exhaust gas temperatures.

7–68. During throttle burst to afterburner setting, the sequence of events is the same as for a military throttle burst until engine speed reaches 90.3 percent and 76.5 degrees throttle angle. Then the main fuel control sends an afterburner on signal and afterburner operation is initiated. The increase of tailpipe pressure caused by light–off results in a rollback of engine speed. The speed generator produces a stronger speed signal (open nozzle signal) because of this rollback in engine speed. At the same time, the main fuel control goes on accel schedule to overcome the rollback; this causes exhaust gas temperature to rise. This sequence of events causes the increasing temperature error signal to call for an open nozzle, the speed signal to call for a more open nozzle, and the reference temperature to be lowered due to the action of the T5 vs. N function. All these interact so that a more open nozzle is called for. This relieves the tailpipe pressure (reducing engine rollback), and minimizes the exhaust gas temperature rise produced by the increased fuel flow while still maintaining a nozzle position that enables rapid engine rpm recovery.

7–69. **THERMOCOUPLE HARNESS.** See figure 7–1. Both chromel and alumel metals are electrical conductors, but they contain different amounts of free electrons. A thermocouple circuit is formed when these two metals are joined and the two junction points are exposed to different temperatures. If one junction, called the reference junction, is maintained at a known constant temperature and the second, or measuring junction (thermocouple), is heated, thermal agitation at the thermocouple causes the free electrons to move and develop a voltage output. This output is a linear function of temperature.

7–70. In the thermocouple harness the thermocouples are combined into two circuits. The output of one circuit is routed to the temperature amplifier for use in controlling exhaust gas temperature. In this circuit the reference junction is located at the temperature amplifier connector. The second circuit supplies a signal to the exhaust gas temperature indicator in the cockpit. The reference junction for this circuit is located at the connection of the indicator.

7–71. **CONTROL ALTERNATOR.** The control alternator is engine driven from the rear face of the transfer gearbox at the 7 o'clock position. Output voltage and frequency are proportional to engine speed. At 100 percent engine speed the ratings are:

Speed	12,442 RPM
Frequency	829 Hz
Voltage	50 $\pm$1 V
Current	0.500 amp

TOOLS AND TEST EQUIPMENT

7–72. **GENERAL.**

7–73. To perform maintenance on the system or components, the special tools and test equipment listed in table 7–2 should be used. Alternate equipment with equal or greater range and accuracy than that in the Alternate Equipment column may be substituted. The listed tools and test equipment are for performing aircraft and shop maintenance procedures in this section of the manual.

Table 7–2. Tools and Test Equipment

Name	Identification No.	Alternate Equip. Range	Alternate Equip. Accuracy	Use
Pressurizing unit, nozzle actuator	1C3569G1			Nozzle system rigging and adjustment.
Nozzle diameter gage	1C2754–1G3 (Part of 1C2754G11)			To record nozzle diameter opening
Nozzle diameter gage	1C2754–1G1 (Part of 1C2754G11)			To record nozzle diameter opening
Actuator synchronizing tool	1C2754–4P1 (Part of 1C2754G11)			To extend nozzle actuator
Wrench, torque		0 to 150 foot–pounds		Filter assembly
Wrench, torque		0 to 200 inch–pounds		Nozzle area control installation

CONTINUED

Table 7-2. Tools and Test Equipment

Name	Identification No.	Alternate Equip. Range	Alternate Equip. Accuracy	Use
Wrench, torque		100 to 750 inch-pounds		Nozzle pump installation
Puller	1C3791			Control-alternator removal

AIRCRAFT MAINTENANCE

7-74. REPLACEMENT AND ADJUSTMENT.

7-75. NOZZLE AREA CONTROL. See figure 7-3.

7-76. **Tools and Equipment.**

Wrench, torque, 0 to 150 inch-pounds

7-77. **Manpower Requirement.**

a. Two men required.

7-78. **Materials.**

O-ring (3 reqd), R149P904A
Lockwire, MS20995NC32
Lockwire, MS20995NC20

7-79. **Removal.**

a. Open door 83L or R.

b. Disconnect following items at nozzle area control:

(1) Electrical lead.

(2) Fuel drain hose.

(3) Servo fuel tube.

(4) Reference fuel tube.

c. Remove bolt and nut that connect nozzle area control output shaft to nozzle pump input lever, then push shaft into control as far as it will go.

d. Free nozzle area control from the nozzle mechanical linkage system as follows:

(1) Connect nozzle actuator tester to engine and pump nozzle closed.

(2) Remove overtravel tube from sheave cover of feedback box.

(3) Loosen conduit nut at other end of sheave cover one turn.

(4) Using a wrench of proper size, hold shaft of control and loosen feedback cable box sheave cover screws enough to permit cover to be raised approximately 1/8 inch. Slowly release remaining spring tension on shaft.

NOTE

Do not permit shaft to unwind rapidly.

(5) Detach conduit from the sheave cover.

(6) Remove sheave cover screws.

(7) Remove sheave cover by sliding it over end of feedback cable.

e. Free nozzle area control from throttle loop mechanical linkage system as follows:

(1) Loosen conduit nut at microadjust unit.

(2) Bend down tab-washer from locknut on control throttle shaft.

(3) Loosen shaft locknut at least 5 turns, and push shaft inward to free sheave.

f. Remove pin that secures control to mounting link.

g. Remove nuts and bolts that secure mounting arms of control to nozzle pump.

h. Remove nozzle area control by tipping top away from engine and then lifting upward.

i. Re-install sheave cover.

7-80. **Installation.**

a. Install throttle linkage cable box and microadjust unit to control. *Torque bolts 22 to 28 inch-pounds, and lockwire.* Install shaft tab washer and locknut. Do not tighten.

b. Assemble a jam nut and new O-ring on each of these 90 degree elbow fittings and install in drain, servo, and reference ports of control. Do not torque at this time.

c. Remove sheave cover from spring box.

d. Loosen throttle shaft locknut at least 5 turns and push shaft inward to free sheave.

e. Position control on engine, guiding open end of throttle loop cable through microadjust unit and cable box and into overtravel tube. Attach upper end of control to mounting link.

f. Attach two arms of control to nozzle pump as follows:

(1) Attach forward arm using a bolt, nut, and washers as required. Install washers, as required, under head of bolt to maintain a minimum clearance of 0.030 inch between end of bolt and nozzle pump input lever. *Torque bolt 120 to 130 inch-pounds.*

(2) Attach rear mounting arm using a bolt, nut, and shims (washers) as required. If a gap exists between arm and pump, use washers to shim gap. This prevents bending stress on mounting arms after rear mounting bolt is torqued. *Torque bolt 120 to 130 inch-pounds.*

g. Attach drain hose, servo tube, and reference tube to elbow fittings. Torque swivel and jam nut. *Lockwire as necessary.*

LEGEND

1. MOUNTING PIN, 2 WASHERS AND COTTER PIN.
2. INLET TUBE (FROM SERVO FUEL FILTER). TORQUE 135-150 LB-IN.*
3. 90° ELBOW, JAM NUT AND O-RING. TORQUE JAM NUT 135-150 LB-IN.*
4. ELECTRICAL LEAD (FROM TEMPERATURE AMPLIFIER) AND SEAL. CONNECT FINGERTIGHT.*
5. CONDUIT. TORQUE 60-80 LB-IN.*
6. MICRO-ADJUST UNIT. TORQUE (TO CABLE BOX) 60-80 LB-IN.*
7. BOLT AND WASHER (QTY-3). TORQUE 30-40 LB-IN.*
8. CAP NUT. TORQUE 30-40 LB-IN.*
9. SPRING BOX.
10. OVERTRAVEL TUBE. TORQUE 60-80 LB-IN.*
11. 90° ELBOW, JAM NUT AND O-RING. TORQUE JAM NUT 135-150 LB-IN.*
12. OUTLET TUBE (TO REFERENCE FUEL MANIFOLD). TORQUE 135-150 LB-IN.*
13. BOLT, TWO WASHERS AND NUT. TORQUE 120-130 LB-IN.
14. SHIM, (AS REQUIRED).
15. CLAMPING BRACKET.
16. OUTLET HOSE (TO DRAIN MANIFOLD). TORQUE 135-150 LB-IN.*
17. BOLT, WASHER AND NUT. TORQUE 120-130 LB-IN.
18. SHIM, (AS REQUIRED).
19. 90° ELBOW, JAM NUT AND O-RING. TORQUE 135-150 LB-IN.
20. CONDUIT. TORQUE 60-80 LB-IN.*
21. MICRO-ADJUST UNIT. TORQUE (TO CABLE BOX) 50-60 LB-IN.*
22. BOLT AND WASHER (QTY-3). TORQUE 24-27 LB-IN.*
23. CABLE BOX.
24. OVERTRAVEL TUBE. TORQUE 10-20 LB-IN.*
25. LOCKNUT AND TABWASHER. TORQUE 30-40 LB-IN.

* LOCKWIRE

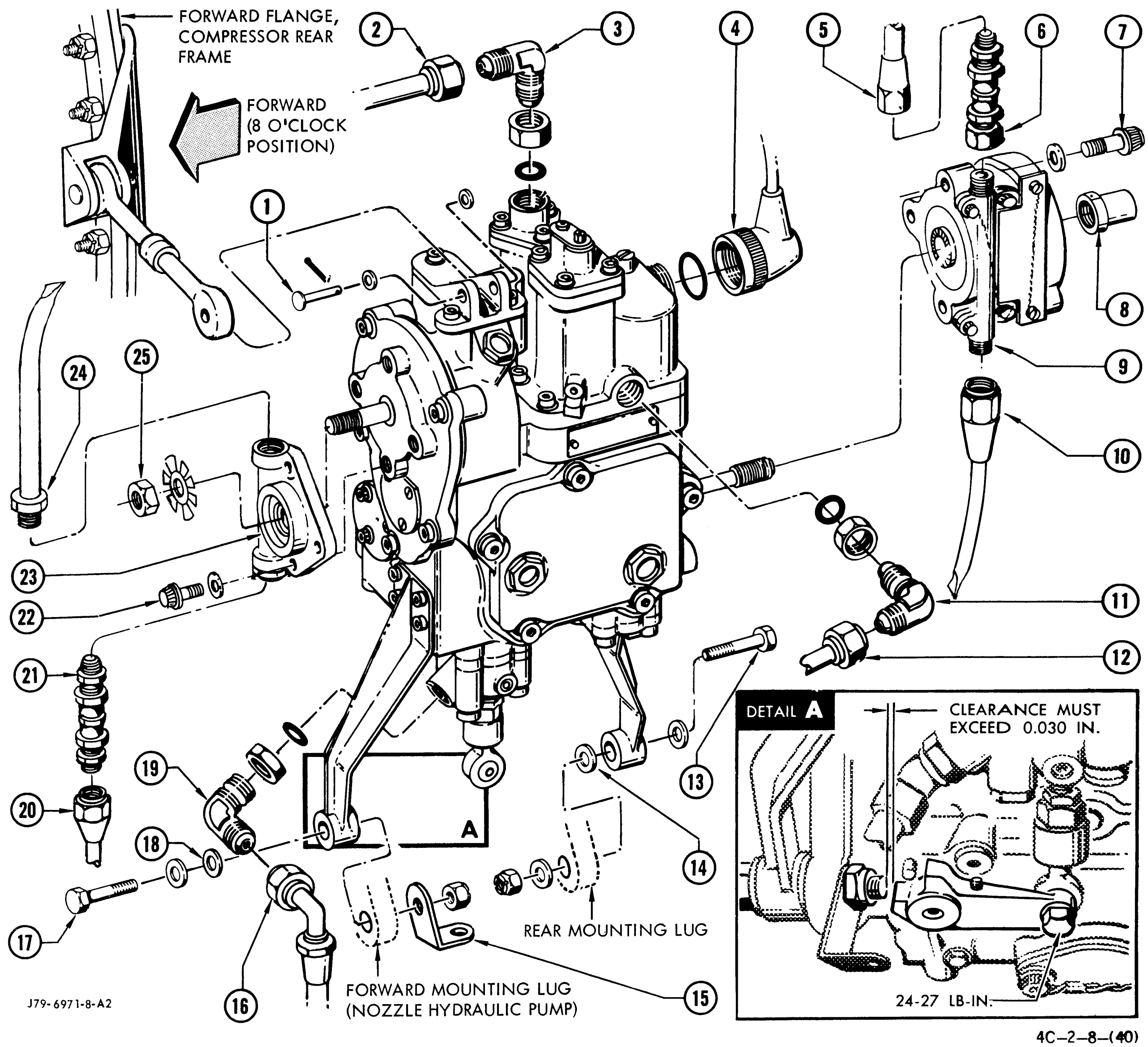


Figure 7-3. Nozzle Area Control Removal and Installation

h. Connect throttle loop conduit to microadjust unit. *Torque 60 to 80 inch-pounds.*

i. Install overtravel tube on other end of throttle loop cable box. *Torque 20 to 30 inch-pounds.*

j. Slide sheave cover over end of feedback cable and loosely attach to spring box.

k. Attach overtravel tube and feedback conduit to ends of sheave cover. *Torque 60 to 80 inch-pounds.*

l. *Rig nozzle area control to nozzle pump linkage.*

m. *Rig throttle input linkage.*

n. *Rig nozzle feedback linkage.*

o. Attach electrical lead to control finger tight. *Lockwire.*

p. *Compartment clear of foreign objects.*

q. *Close door 83 L or R.*

7-81. **NOZZLE PUMP.** See figure 7-4.

7-82. **General.** The nozzle hydraulic pump must be replaced if the engine was operated under any of the following conditions:

a. Engine was operated without oil, or quantity of oil in tank was so low that tank priority system prevented flow to hydraulic system.

b. Nozzle failed open due to lack of hydraulic pressure even though indicated oil pressure was normal.

c. Hydraulic element of main lube and hydraulic pump has failed.

d. Oil tank hydraulic oil pickup has stuck in up position.

e. Any restrictions are found in hydraulic lines or filter which would greatly restrict oil flow.

f. Any nozzle manifold lines to nozzle actuators have failed or have leaked substantially.

g. Nozzle operation was normal, but oil consumption was more than 16 pints.

h. Any malfunction of nozzle pump is suspected, regardless of amount of oil loss.

7-83. **Tools and Equipment.**

Pressurizing unit, nozzle actuator, 1C3569G1
Wrench, torque, 100 to 750 inch-pounds

7-84. **Materials.**

Lockwire, MS20995NC32
O-ring (2 reqd), R149P908A

7-85. **Removal.**

a. Open door 83 L or R.

b. Remove nozzle area control seal drain hose.

c. Remove feedback overtravel tube from feedback cable box.

d. Disconnect scavenge oil line from fitting on rear gearbox scavenge pump. Reposition to clear nozzle pump.

e. Disconnect actuator tubes from nozzle hydraulic filters.

f. Remove bolt and nut that connect nozzle area control output rod to nozzle pump control lever. Move output rod into nozzle area control until it stops.

NOTE

Advancing throttle to military permits rod to be pushed in further.

g. Disconnect oil inlet hose from pump.

h. Remove nuts, washers, and bolts that secure nozzle area control to nozzle pump.

i. Remove nuts and washers that secure pump to gearbox.

j. Lifting nozzle area control clear of pump, carefully remove pump. Use wire or leather tie to support nozzle area control.

k. Remove nuts and bolts that secure nozzle hydraulic filters to pump bracket. Disconnect filters from pump. Remove fittings from pump as required.

7-86. **Installation.**

a. *Place retainers and O—rings on each connector.* Install connector in nozzle pump outlet ports. Using thin head open end crowfoot attachment, *torque connector 270 to 300 inch—pounds and lockwire.*

b. Assemble jam nut and O—ring on 90° elbow and install in pump inlet port. Position elbow to point to rear of pump. *Torque jam nut 180 to 200 inch-pounds and lockwire.*

c. Assemble filters to brackets.

(1) *Torque nuts 55 to 70 inch—pounds.*

(2) Connect filter brackets to pump bracket with nuts finger tight.

(3) Attach connector coupling nuts to filters. Use thin open end wrench to restrain connectors at pump.

(4) *Torque connector coupling nuts 450 to 550 inch—pounds and lockwire.*

(5) *Torque filter bracket bolts 55 to 70 inch—pounds.*

d. Position pump and connect inlet hose to elbow in pump inlet.

(1) *Torque hose 270 to 300 inch—pounds and lockwire.*

(2) *Install pump with gasket, on gearbox pad.*

(3) *Torque nuts 100 to 130 inch—pounds.*

e. Secure nozzle area control to nozzle pump.

(1) Connect long (forward) mounting arm of control to forward lug of nozzle pump.

(2) *Position bolthead forward.* Add shims as required under bolthead to *maintain minimum clearance of 0.030 inch between rear end of bolt and nozzle control arm.*

(3) *Install L—shaped clamping bracket under nut pointing rearward.*

(4) *Torque nut 120 to 130 inch—pounds.*

(5) *After torquing, be certain chamfered end of bolt is visible beyond nut.*

(6) *If gap exists between short mounting arm and rear lug of pump, shim gap so there will be no bending stress on mounting arm when bolt is tightened.*

(7) Install bolt and *torque nut 120 to 130 inch—pounds.*

(8) Connect nozzle area control rod—end bearing to nozzle hydraulic pump lever arm, *with bearing on inboard side of arm. Bolthead must be outboard.*

(9) Move nozzle hydraulic pump arm and inspect clearance between end of bolt (and nut, if applicable) and pump housing. *Minimum clearance is 0.010 inch.* Add washers under bolthead to get clearance.

(10) *Torque bolt 24 to 27 inch—pounds.*

(11) Line up index mark on nozzle area control output shaft with rigging pin access hole. Place tab—washer on shaft and thread bearing several turns on shaft.

(12) Rig nozzle area control to nozzle pump linkage.

f. Install following tubes and hoses:

(1) Connect nozzle pump inlet manifold to pump pressure relief valve. Do not torque coupling nut until pump priming procedure is completed.

(2) Install overtravel tube on nozzle feedback cable box and in clamp on rear of scavenge pump. *Torque overtravel tube 10 to 20 inch-pounds.*

(3) Connect rear gearbox scavenge pump outlet tube to pump outlet connector. *Torque fitting 450 to 550 inch—pounds, lockwire, and install clamps.*

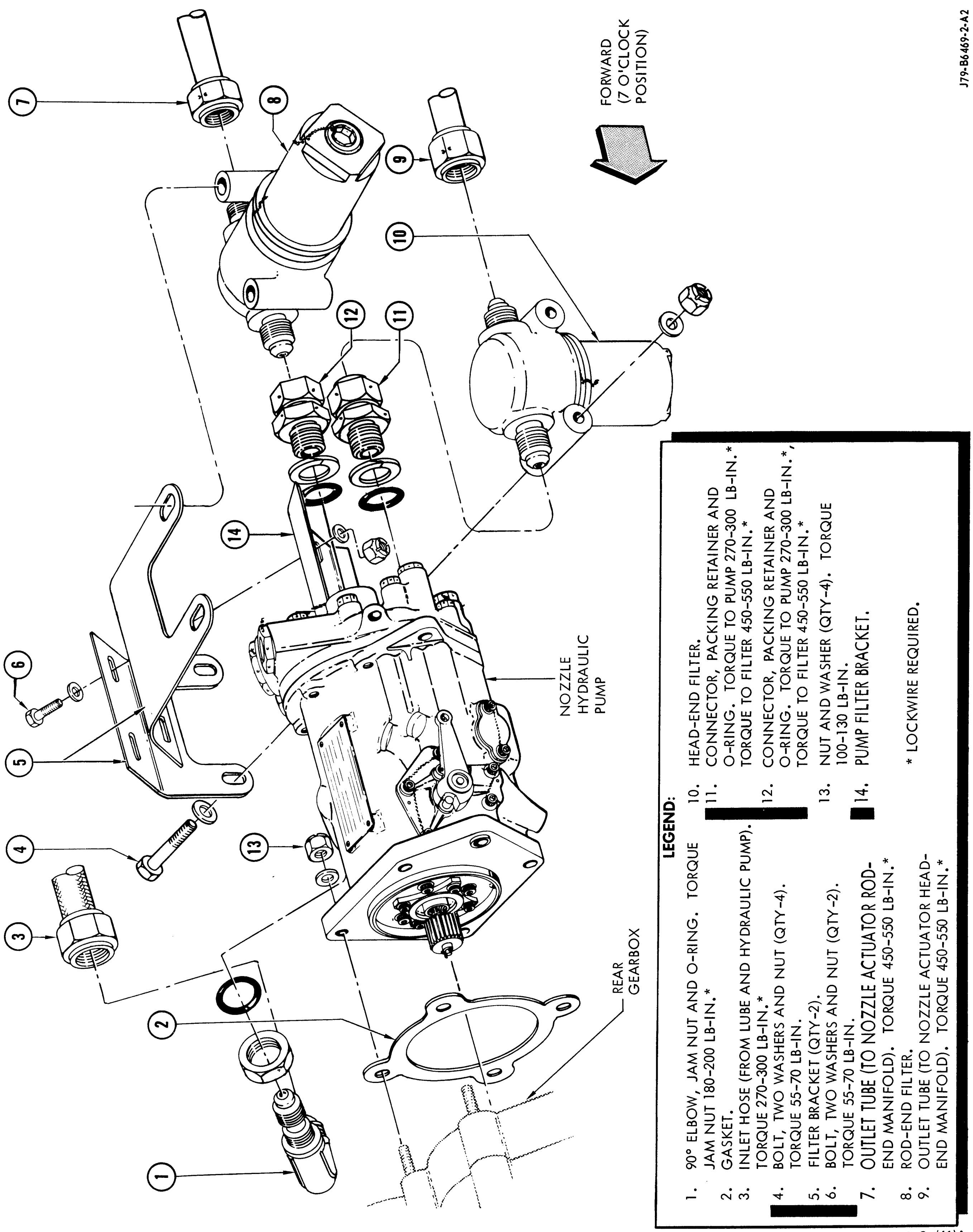
(4) Install torch igniter signal tube tee between check and vent valve, and signal hose.

(5) Install signal tube between on—off valve and signal tube tee. Tighten and *lockwire four coupling nuts. Install clamps.*

(6) Install nozzle hydraulic actuator head—end and rod—end tubes between nozzle filters and head—end and rod—end manifolds near rear flange of forward exhaust duct. Tighten fittings, *lockwire and install clamps.*

g. Prime nozzle pump. Refer to paragraph 7—78.

h. Close door 83L or R.



LEGEND:

1. 90° ELBOW, JAM NUT AND O-RING. TORQUE JAM NUT 180-200 LB-IN.*
2. GASKET.
3. INLET HOSE (FROM LUBE AND HYDRAULIC PUMP). TORQUE 270-300 LB-IN.*
4. BOLT, TWO WASHERS AND NUT (QTY-4). TORQUE 55-70 LB-IN.
5. FILTER BRACKET (QTY-2).
6. BOLT, TWO WASHERS AND NUT (QTY-2). TORQUE 55-70 LB-IN.
7. OUTLET TUBE (TO NOZZLE ACTUATOR ROD-END MANIFOLD). TORQUE 450-550 LB-IN.*
8. ROD-END FILTER.
9. OUTLET TUBE (TO NOZZLE ACTUATOR HEAD-END MANIFOLD). TORQUE 450-550 LB-IN.*
10. HEAD-END FILTER.
11. CONNECTOR, PACKING RETAINER AND O-RING. TORQUE TO PUMP 270-300 LB-IN.* TORQUE TO FILTER 450-550 LB-IN.*
12. CONNECTOR, PACKING RETAINER AND O-RING. TORQUE TO PUMP 270-300 LB-IN.*, TORQUE TO FILTER 450-550 LB-IN.*
13. NUT AND WASHER (QTY-4). TORQUE 100-130 LB-IN.
14. PUMP FILTER BRACKET.

* LOCKWIRE REQUIRED.

Figure 7-4. Nozzle Pump Removal and Installation

7-87. **Flushing and Priming.**

7-88. Tools and Equipment.

Wrench, torque, 100-750 inch-pounds
Nozzle actuator pressurizing unit, 1C3569G1

7-89. Manpower Requirement.

a. Two men required.

7-90. Materials.

Oil, lubricating gas turbine aircraft, MIL-L-7808
O-ring (2 reqd), R149P906C
Lockwire, MS20995NC32

7-91. Procedure.

NOTE

Following procedure shall be accomplished any time a component or line in hydraulic system is removed and/or replaced. If cause of pump failure is known and fault corrected, install new pump.

a. Open doors 83 L or R and 96 L or R.

b. Remove all lube and hydraulic system filters and inspect for cleanliness. Clean filter elements and bowls. Refer to paragraph 7-108 for proper filter cleaning procedures. If excessive amount of contamination is found in filters, drain oil, flush system and fill tank with clean oil. See figure 7-6.

c. Remove hydraulic hose between pump and filter and hydraulic hose between pressure relief valve and pump. Flush both hoses with clean oil.

NOTE

For reason of accessibility it is more convenient to remove hydraulic hose between nozzle pump and filter while pump is being replaced.

d. Remove hydraulic pressure relief valve from rear gearbox scavenge pump and inspect it for contamination. If contaminated, replace valve.

e. Install parts removed in step b, c and d.

CAUTION

Assure flow-direction arrow on pressure relief valve is pointing toward front of engine.

f. *Use new O-rings when installing hydraulic pressure relief valve, torque to 125 inch-pounds and secure with lockwire.*

g. Loosen hose between pressure relief valve on rear gearbox scavenge pump and oil inlet manifold hose to pump, at tee of manifold hose. Loosen B-nut several turns so it leaks when pressure is applied.

h. Remove caps from rod end and head end line pressure taps in lines to nozzle actuators.

i. Attach pressurizing unit to head end and rod end pressure taps.

j. Pump exhaust nozzle full open, then closed. Oil should flow from loose connection. *If additional pumping is necessary to obtain oil flow, cause should be investigated.*

NOTE

Do not exceed 300 psi when pumping nozzle open or closed.

k. Pump nozzle full open.

l. Disconnect hydraulic unit from pressure taps.

m. Install caps on pressure taps, but leave B-nut at tee of manifold hose loose.

n. *Assure oil tank is full.*

o. Motor engine until oil starts to leak through loose connection.

p. As soon as there is steady flow of oil from loose connection, cease motoring.

q. Tighten loose connection at tee. *Torque B-nut 270 to 300 inch-pounds.*

r. Run engine at IDLE for 5 minutes to scavenge excess oil from gearboxes. *During this run inspect hydraulic and nozzle system for leaks.*

s. Shut down engine and check oil level in tank. *Drain any excess oil from tank or service if necessary.*

NOTE

During priming procedure oil is ported through nozzle pump cooling port into rear gearbox.

t. *Close doors 83 L or R and 96 L or R.*

7-92. **NOZZLE ACTUATOR.** See figure 7-5.

7-93. **Tools and Equipment.**

Gage, nozzle diameter, 1C2754-1G3
Gage, nozzle diameter, 1C2754-1G1
Pressurizing unit, nozzle actuator, 1C3569G1
Tool, actuator synchronizing, 1C2754-4G1

7-94. **Manpower Requirement.**

a. Two men required.

7-95. **Materials.**

Cotter pins
Lockwire, MS20995NC32

7-96. **Removal.**

a. Open door 96 L or R.

b. Connect nozzle actuator tester. Actuate nozzle to open position.

c. Remove rod end pressure and seal drain tubes, and disconnect head end pressure tubes between actuator being removed and adjacent actuators.

d. Loosen turnbuckle jam nut.

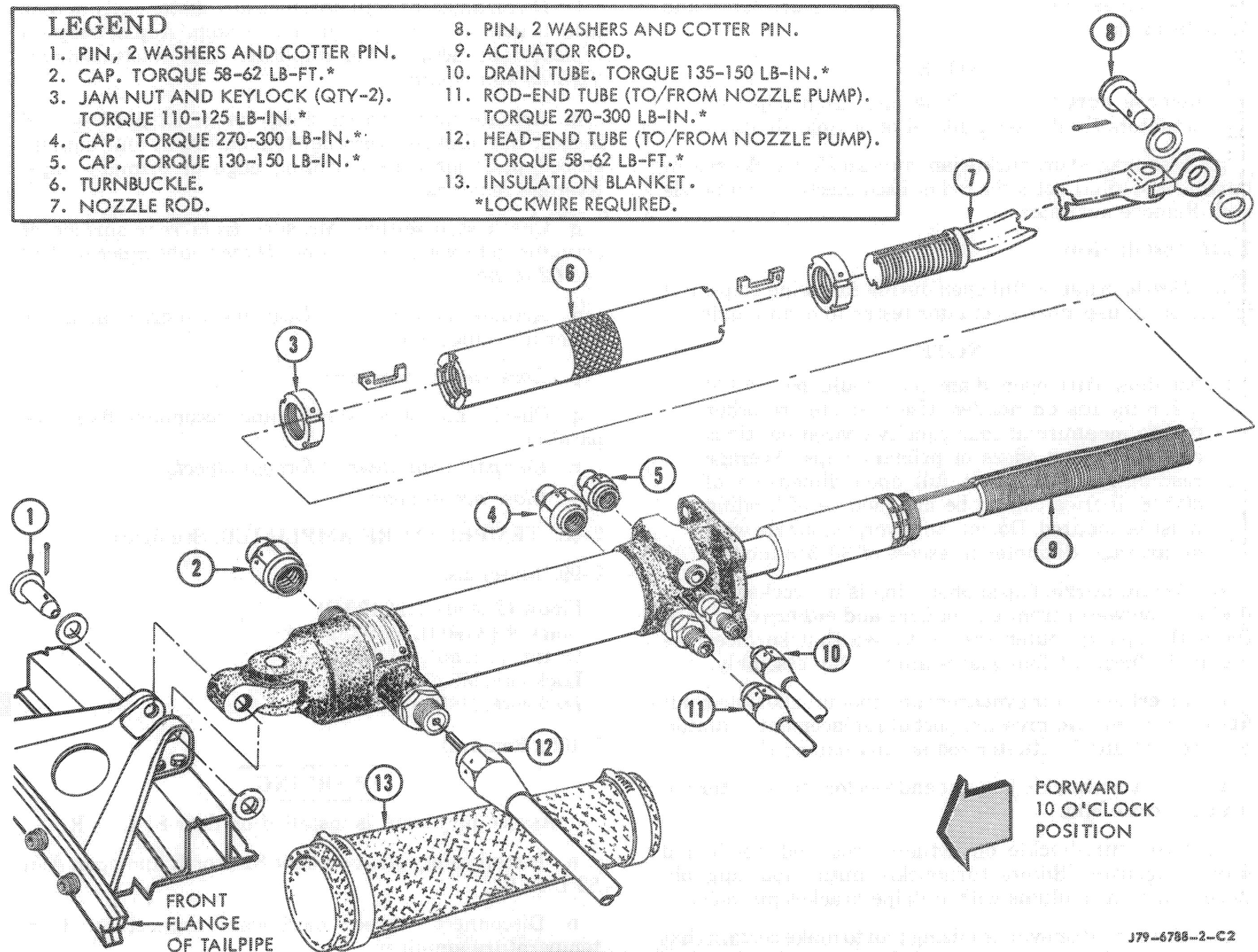
e. Remove actuator attaching pin at head end of actuator.

f. Disengage flexible synchronization shafts inside the

LEGEND

1. PIN, 2 WASHERS AND COTTER PIN.
2. CAP. TORQUE 58-62 LB-FT.*
3. JAM NUT AND KEYLOCK (QTY-2). TORQUE 110-125 LB-IN.*
4. CAP. TORQUE 270-300 LB-IN.*
5. CAP. TORQUE 130-150 LB-IN.*
6. TURNBUCKLE.
7. NOZZLE ROD.
8. PIN, 2 WASHERS AND COTTER PIN.
9. ACTUATOR ROD.
10. DRAIN TUBE. TORQUE 135-150 LB-IN.*
11. ROD-END TUBE (TO/FROM NOZZLE PUMP). TORQUE 270-300 LB-IN.*
12. HEAD-END TUBE (TO/FROM NOZZLE PUMP). TORQUE 58-62 LB-FT.*
13. INSULATION BLANKET.

*LOCKWIRE REQUIRED.



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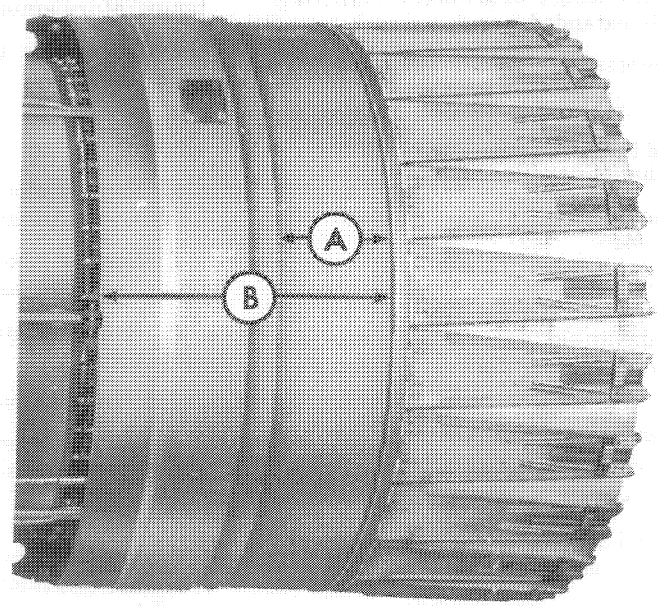

A. DISTANCE BETWEEN REAR END OF SHROUD AND FRONT END OF FLAPS.

B. DISTANCE BETWEEN FRONT END OF SHROUD AND FRONT END OF FLAPS.

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Figure 7-5. Nozzle Actuator Removal and Installation

head end pressure tubes and remove pressure tubes and flexible shafts.

NOTE

Remove actuator attaching pins from adjacent actuators facilitates removal of flexible shafts.

g. Disengage turnbuckle jam nuts and key locks. Screw turnbuckle until actuator rod is disconnected from nozzle rod. Remove actuator.

7-97. Installation.

a. Nozzle must be full open during following steps. If it is not open, use nozzle actuator tester to open nozzle.

NOTE

Nominal full open diameter should be 30 1/4 ±1/8 inches on nozzles. Use diameter recorder tool to measure at four equally spaced positions across trailing edges of primary flaps. Average readings. If minimum full open dimension of 30 1/8 inches cannot be met, source of binding must be located. Do not, however, rig nozzle with an average diameter in excess of 30 3/8 inches.

b. Assure nozzle flap support ring is not cocked. Check distance between front end of flaps and either rear (A) or front (B) end of outer shroud to see that surfaces are parallel. Check at four places around flap assembly.

c. Insert actuator synchronizing tool into flexible shaft fitting in head end pressure port of replacement actuator. Rotate tool until actuator rod is fully extended.

d. Fit a turnbuckle jam nut and key lock to actuator rod and to nozzle rod.

e. Start turnbuckle on actuator rod and nozzle rod simultaneously. Rotate turnbuckle until mounting pin hole of actuator aligns with tailpipe bracket pin hole.

f. Use actuator synchronizing tool to make certain that actuator rod is still fully extended.

g. Install head end pressure tubes and flexible shafts.

NOTE

Removing attaching pins from adjacent actuators facilitates installation of flexible shafts.

h. *Install actuator mounting pin(s), washers, and cotter pins.*

i. Rotate turnbuckle (in direction to shorten actuator rod assembly a small amount) at least 1/4 turn but not more than 1/2 turn to line up slot in turnbuckle with key lock. *Torque turnbuckle locknuts. Lockwire turnbuckle locknuts to key locks.*

j. *Install rod end pressure, head end pressure, and drain tubes to actuator and torque.*

NOTE

When tightening head and rod end pressure and drain tubes, hold fittings in actuators to keep fittings from turning.

k. Install tube restraining clamps to head end, rod end, and drain tubes midway between actuators. Install clamps between 4 and 8 o'clock actuators where rod end and seal drain tubes bend at 4 o'clock actuator below tee fitting on head end tube at 8 o'clock actuator.

l. On an adjacent actuator, measure distance from rear face of actuator to forward end of stop. Adjust stop on replacement actuator to duplicate this measurement. *Tighten stop jam nut.*

m. Actuate nozzle to rig diameter of 22 5/16 ±1/16 inches. Use diameter recorder to measure at four equally spaced positions across trailing edge of primary flaps. Average readings.

n. Check stop setting. Measure from rear surface of actuator to forward end of stop. *Dimensions must be 1.84 ±0.02 inches.*

o. Actuate nozzle open. Disconnect nozzle actuator tester (if connected).

p. *Lockwire as necessary.*

q. Check that outer shroud and secondary flaps are parallel.

r. *Compartment clear of foreign objects.*

s. *Close access door.*

7-98. TEMPERATURE AMPLIFIER. See figure 7-6.

7-99. Materials.

Elbow (2 reqd), R294P04D
Jam nut (2 reqd), MS9201-04
O-ring (2 reqd), R149P904A
Lockwire, MS20995NC32
Lockwire, MS20995NC20

7-100. Removal.

WARNING

Assure jury strut is installed on door 81 L or R.

a. Install safety strut on door 81 L or R and open door 82 L or R.

b. Disconnect three electrical connectors from temperature amplifier.

c. Disconnect temperature amplifier fuel inlet tube hose from elbow.

d. Disconnect outlet medium pressure teflon hose from elbow.

e. Remove elbow, jam nut, and O-ring from inlet port on temperature amplifier.

f. Remove elbow, jam nut, and O-ring from outlet port on temperature amplifier.

g. Remove four hold down bolts from temperature amplifier.

7-101. Installation.

a. Place temperature amplifier in position on mounting bracket and install four holddown bolts.

b. Deleted.

c. Install elbow, O-ring, and jam nut into temperature amplifier fuel inlet port. Screw elbow all way in then back it off as necessary to align with fuel inlet tube hose.

d. *Torque jam nut 135 to 150 inch-pounds and lockwire.*

e. Install elbow, jam nut, and O-ring into temperature amplifier fuel outlet port. Screw elbow all the way in then

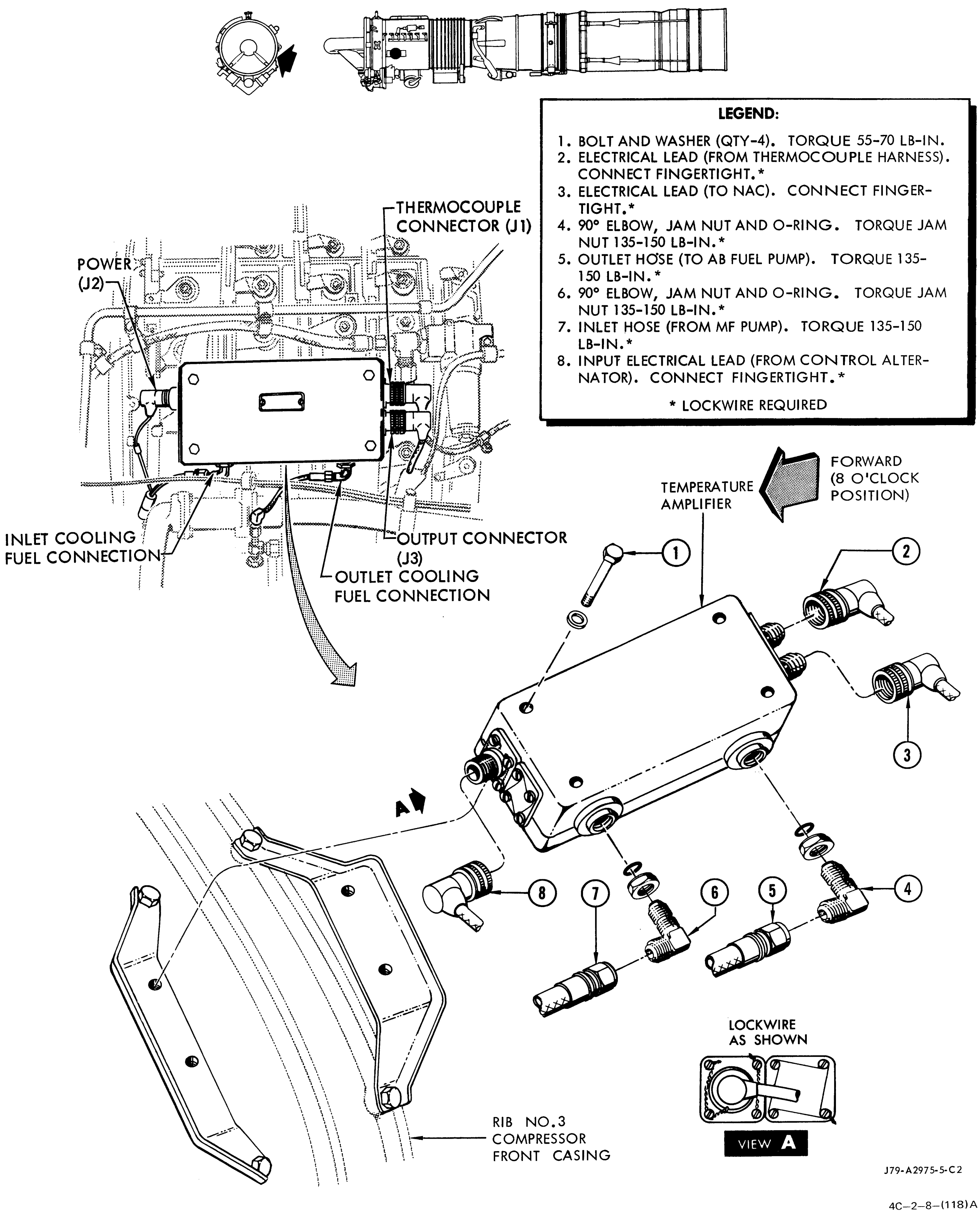


Figure 7-6. Temperature Amplifier Removal and Installation

back it off as necessary to align with fuel outlet tube hose.

f. *Torque jam nut 135 to 150 inch-pounds and secure with lockwire.*

g. *Connect fuel inlet hose to inlet elbow.*

h. *Torque fitting 135 to 150 inch—pounds and secure with lockwire.*

i. *Connect fuel outlet hose to outlet elbow.*

j. *Torque fitting 135 to 150 inch—pounds and secure with lockwire.*

k. *Connect three electrical connectors to temperature amplifier and secure with lockwire.*

l. *Perform functional check of exhaust gas temperature system. Refer to figure 2-21.Check for fuel leakage at next engine runup; no fuel leakage permitted.*

m. *Close door 82 L or R.*

7-102. **THERMOCOUPLES.** The engine must be removed to gain access to the thermocouples. Refer to T.O.2J-J79-46, to remove thermocouples from engine.

7-103. **CONTROL ALTERNATOR.** See figure 7-7.

7-104. **Tools and Equipment.**

Wrench, torque, 0 to 200 inch-pounds
Puller, 1C3791G1

7-105. **Materials.**

Gasket, 416B253P2
Lockwire, MS20995NC32
Lockwire, MS20995NC20

7-106. **Removal.**

a. Open door 82 L or R.

b. Remove lockwire and disconnect electrical connector from alternator.

c. Remove four hold-down nuts and washers.

d. Remove attaching clamp brackets.

e. Remove alternator body and gasket.

f. Bend tab—washer open and remove locknut (left hand thread) and tab—washer from gearbox shaft, or the self—locking nut.

NOTE

Thread of gearbox shaft is left band.

g. Using puller, remove rotor from gearbox shaft.

7-107. **Installation.**

NOTE

Rotor and case of control alternator are matched to each other and have same serial number. If alternator is faulty, replace both rotor and case with a matched set.

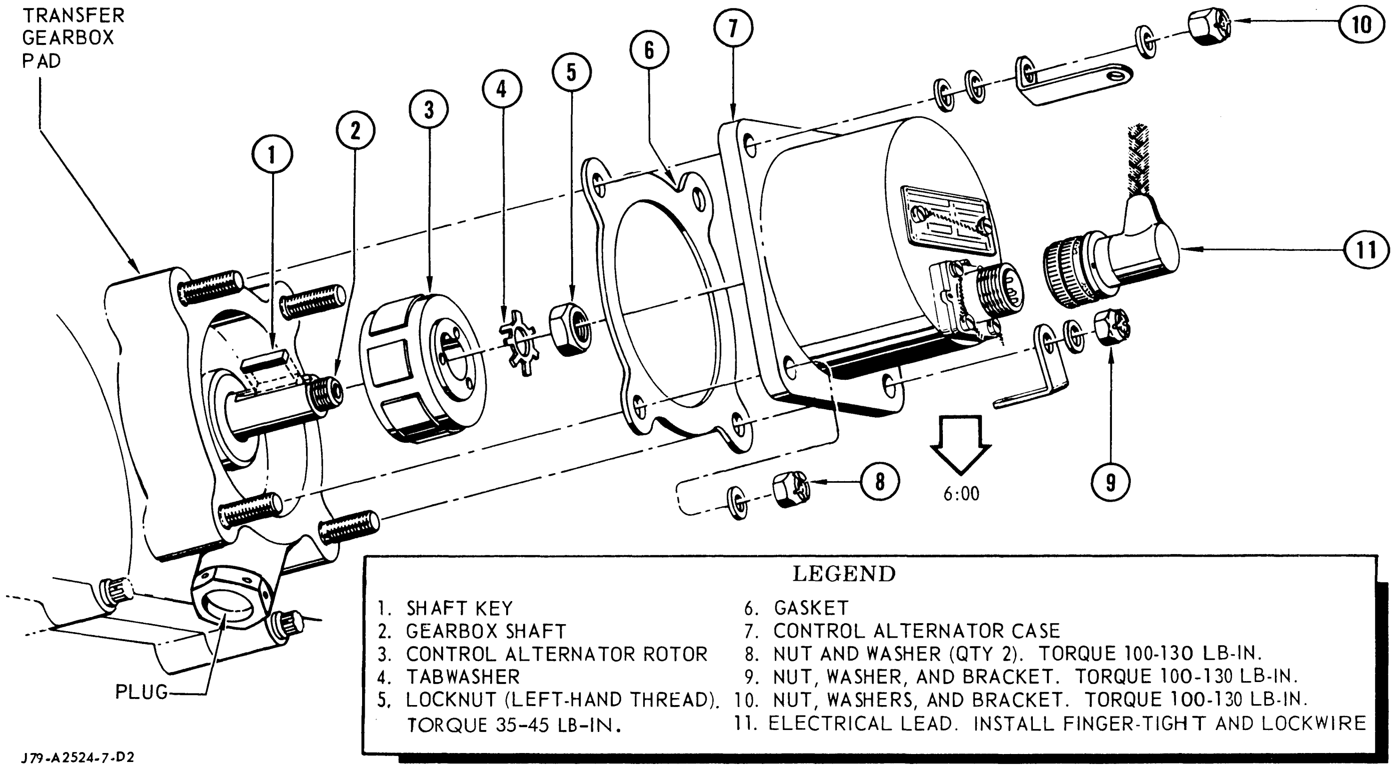
a. Align key slots and slide rotor on gearbox shaft.

b. Install key in slot.

c. Install tab—washer and nut (left hand thread), or self—locking nut.

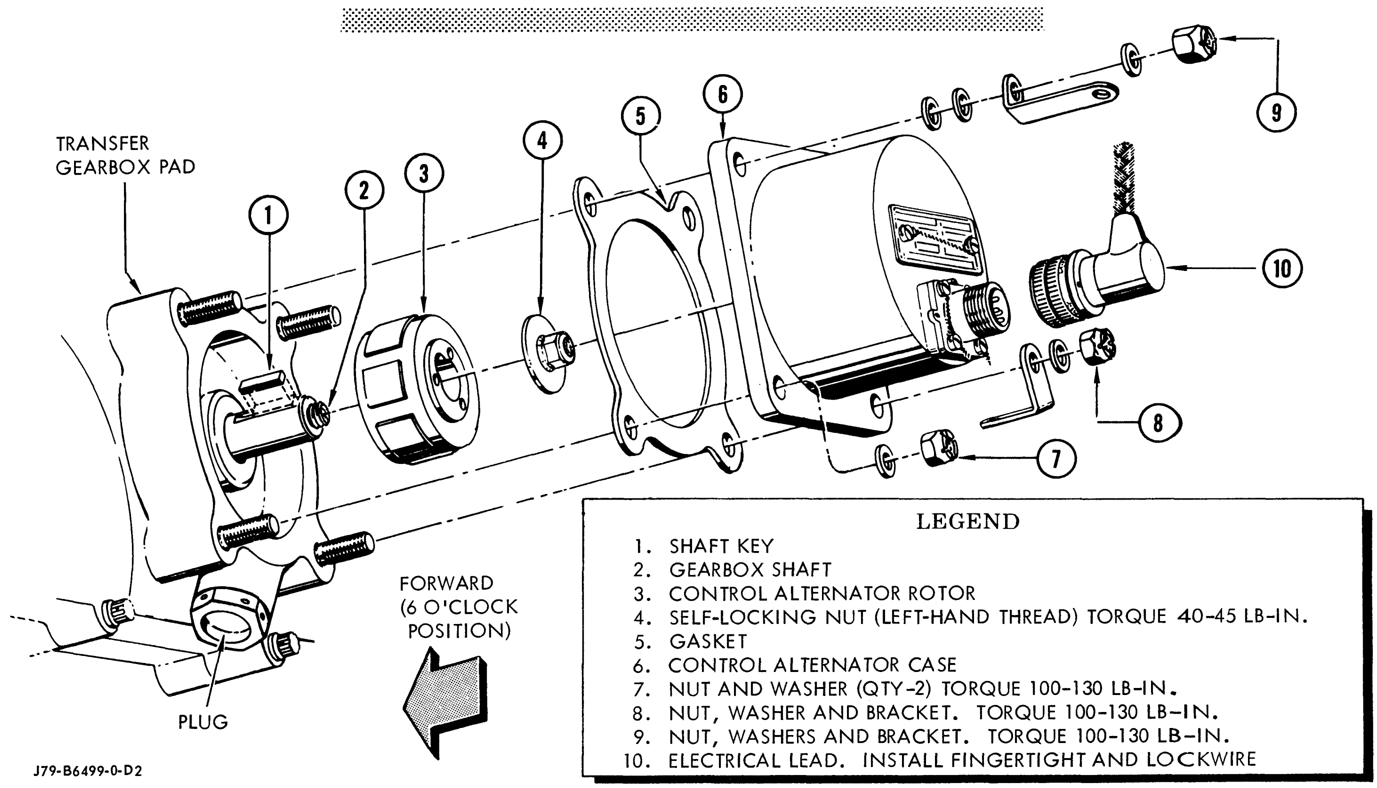
d. *Torque nut 35 to 45 inch—pounds. Lock nut by bending tab. Torque self—locking nut 40 to 45 inch—pounds.*

e. Install gasket between body and gearbox, and slide body over rotor and studs.



LEGEND

1. SHAFT KEY
2. GEARBOX SHAFT
3. CONTROL ALTERNATOR ROTOR
4. TABWASHER
5. LOCKNUT (LEFT-HAND THREAD). TORQUE 35-45 LB-IN.
6. GASKET
7. CONTROL ALTERNATOR CASE
8. NUT AND WASHER (QTY 2). TORQUE 100-130 LB-IN.
9. NUT, WASHER, AND BRACKET. TORQUE 100-130 LB-IN.
10. NUT, WASHERS, AND BRACKET. TORQUE 100-130 LB-IN.
11. ELECTRICAL LEAD. INSTALL FINGER-TIGHT AND LOCKWIRE



LEGEND

1. SHAFT KEY
2. GEARBOX SHAFT
3. CONTROL ALTERNATOR ROTOR
4. SELF-LOCKING NUT (LEFT-HAND THREAD) TORQUE 40-45 LB-IN.
5. GASKET
6. CONTROL ALTERNATOR CASE
7. NUT AND WASHER (QTY-2) TORQUE 100-130 LB-IN.
8. NUT, WASHER AND BRACKET. TORQUE 100-130 LB-IN.
9. NUT, WASHERS AND BRACKET. TORQUE 100-130 LB-IN.
10. ELECTRICAL LEAD. INSTALL FINGERTIGHT AND LOCKWIRE

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Figure 7-7. Control Alternator Removal and Installation

f. Install attaching clamp brackets.

g. Install four washers and hold down nuts.

h. *Torque hold down nuts 100 to 130 inch-pounds.*

i. *Connect electrical connector to alternator and secure with lockwire.*

j. *Close door 82 L or R.*

7-108. CLEANING, DRAINING AND LUBRICATION.

7-109. CLEANING.

7-110. **Nozzle Hydraulic Filters.** See figure 7-8.

7-111. Tools and Equipment.

Wrench, torque, 0 to 200 inch-pounds
Ultrasonic cleaning unit
Wrench, torque, 0 to 150 inch-pounds

7-112. Materials.

Solvent, dry cleaning, P-D-680
Lockwire, MS20995NC32

7-113. Disassembly.

NOTE

Left and right nozzle hydraulic filters are similar.

a. Remove lockwire and drain plug from filter bowl and allow oil to drain into a suitable container.

b. Remove lockwire and unscrew filter bowl from filter head.

c. Remove bowl and filter element.

d. Remove filter element from bowl.

7-114. Cleaning.

NOTE

In addition to the filter cleaning instructions contained herein, refer to T.O.9H3-1-1, and comply accordingly.

a. Before cleaning element, cover end with a suitable fixture to prevent contaminant from entering interior of filter.

b. Clean filter element and bowl using cleaning solvent and a brush that has soft bristles longer than depth of pleats in filter element.

c. A preferred alternate method of cleaning is ultrasonic cleanig if equipment is available. Clean filter for 5 minutes at room temperature using trichlorethylene or equivalent. Position element horizontally in cleaning tank and rotate 90 degrees after each minute of cleaning. Backflush if possible.

CAUTION

Air pressure must not exceed 40 psig maximum to prevent filter element damage.

d. Shake or blow excess solvent from filter element.

7-115. Inspection.

a. Inspect filter element for tears, buckling, obstructions, and residual contamination.

b. Inspect seal seating surfaces for burrs.

7-116. Assembly.

a. Insert filter element into bowl.

b. Screw bolt into filter head.

c. *Torque bowl from 65 to 70 foot-pounds.*

d. *Secure bowl with lockwire.*

e. *Install drain plug. Torque from 120 to 145 inch-pounds and secure with lockwire.*

7-117. Testing.

a. Check assembled filter for leaks during engine operation.

7-118. **Thermocouple Harness Connectors.**

7-119. Tools and Equipment.

Wrench, torque 0 to 200 inch-pounds
Wrench, torque 100 to 750 inch-pounds

7-120. Materials.

Compound, Cleaning, SPRA KLEEN 8666

7-121. Disassembly.

a. Disconnect thermocouple harness from rigid thermocouple lead.

b. Disconnect rigid lead from flexible lead.

c. Disconnect flexible lead from temperature amplifier connector J1.

d. Disconnect flexible lead from electrical junction bracket.

e. Disconnect flexible lead at nozzle area control and temperature amplifier connector J3.

7-122. Cleaning.

a. Apply SPRA KLEEN to small bristle brush or pipe stem cleaner and scrub sockets and pins to remove contaminants.

b. Clean inside of connectors and sealing surfaces as described above.

c. Allow connector to dry for 30 minutes.

7-123. Assembly.

a. Assure sealing ring is present in each connector prior to mating connector halves.

b. Install connectors. Torque connectors with metal seals 180 to 240 inch-pounds (these include rigid lead connectors to thermocouple harness); torque other connectors 40 to 60 inch-pounds.

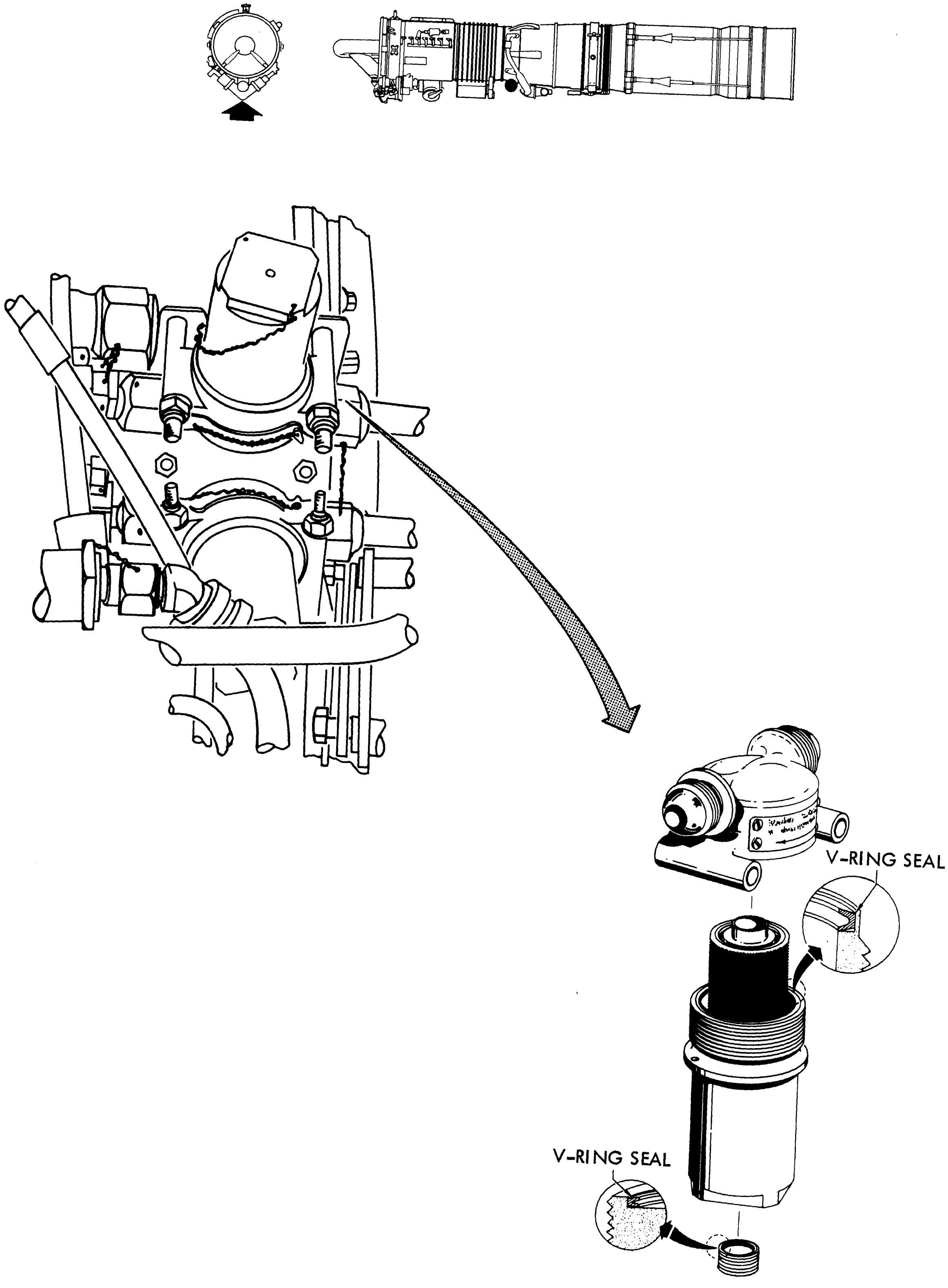

Figure 7-8. Nozzle Hydraulic Filters

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7–124. Testing. Perform engine checkout, refer to section II.

7–125. **LUBRICATION.**

7–126. **Filter Priming.** If any component in the nozzle hydraulic system is removed, causing a loss of prime to the nozzle pump, the nozzle hydraulic system must be reprimed to prevent cavitation and failure of the nozzle pump. The filters affecting the nozzle hydraulic system are the two nozzle hydraulic filters and the hydraulic element of the lube and hydraulic filter. It is recommended that the filter bowls of these three filters be filled with engine lubricating oil after cleaning and prior to installation on the engine as an aid to the priming procedure given in paragraph 7–87.

7–127. **Nozzle Feedback Cables.** Refer to section IV for lubrication of the nozzle feedback cables.

SHOP MAINTENANCE

7–128. **MAINTENANCE PROCEDURES.**

7–129. This section provides maintenance procedures applicable to components/systems when removed from the aircraft. Table 7–3 lists the functional line replaceable units (LRU) of the system with the location of applicable maintenance procedures. Shop maintenance procedures, when contained in this manual are referenced by paragraph numbers; when contained in accessory publication, the T.O. numbers of the applicable manuals are listed. Manuals in the F–4 series or in general aircraft series are listed when containing procedures directly applicable to the LRU. When separate overhaul/illustrated parts breakdown manuals have been provided, the T.O. numbers are listed.

Table 7–3. Line Replaceable Units

Line Replaceable Unit	Manufacturers Part Number	Applicable Maintenance Procedures/Publications Shop (Intermediate Level)	Applicable Maintenance Procedures/Publications Overhaul/IPB
Nozzle area control	512D728G	T.O.2J–J79–46	
Nozzle pump	512D866P	T.O.2J–J79–46	
Nozzle actuator	868C985P	T.O.2J–J79–46	
Temperature amplifier	874C585P	T.O.2J–J79–46	
Thermocouples	108R531P 108R532P	T.O.2J–J79–46	
Control alternator	868C691P	T.O.2J–J79–46	

7–130. **PACKAGING.**

7–131. Components to be forwarded to the next higher level of maintenance for repairs, test, or check must be cleaned, preserved and packaged for protection against physical and mechanical damage during subsequent handling, shipping and storage. For preservation and packaging methods referred to herein, refer to AFP71–4 volumes 1 and 2. Components packed for forwarding must further be identified, marked and documented in accordance with applicable Air Force procedures.

SECTION VIII

LUBRICATION SYSTEM

DESCRIPTION

8–1. **SYSTEM.** See figure 8–1.

8–2. The lubrication system comprises three subsystems which assure adequate lubrication and cooling of the engine bearings, seals, and accessory drive gears. An oil supply subsystem filters and discharges oil under high pressure onto the main engine bearings and seals and the accessory drive gears and bearings. A scavenge subsystem recovers the oil from the bearing sumps and gearboxes, filters and cools it, and returns it to the oil tank for reuse. A tank pressurizing and sump vent subsystem maintains the proper air pressure relationships in the oil tank and bearing sumps to ensure proper functioning of the lube pump and the oil seals.

8–3. **COMPONENTS.**

8–4. **LUBE SUPPLY SUBSYSTEM.**

a. Oil tank.

b. Main lube and hydraulic pump.

c. Lube and hydraulic filter.

d. Pressure transmitter relief valve.

e. Lube nozzles.

f. Nozzle pump inlet pressure relief valve.

g. Oil tank fill/drain line filter.

8–5. **SCAVENGE SUBSYSTEM.**

a. Transfer gearbox scavenge pump.

b. Rear gearbox scavenge pump.

c. No. 3 bearing scavenge pump.

d. Scavenge oil filter.

e. Anti–static leakage check valve.

f. Afterburner oil cooler.

g. Main oil cooler.

h. Air oil cooler.

i. Air oil cooler pressure relief valve.

8–6. **TANK PRESSURIZING AND SUMP VENT SUBSYSTEM.**

a. Bearing sumps and gearboxes.

b. Tank pressurizing and sump vacuum relief valve.

c. Sump vent check valve.

8–7. **OIL TANK.** See figure 8–1. The oil tank stores the oil used in the lubrication system, the variable nozzle system, and in the aircraft constant speed drive and electrical generating system.

8–8. The oil tank, which is between the 12 and 3 o'clock positions on the compressor front casing, has an oil capacity of 5.3 $\pm$0.2 gallons. The tank is constructed such that oil supply to the lubrication system is interrupted during inverted flight, due to the inability of the scavenge pumps to recover the oil from the sumps and gearboxes. The tank will supply oil to the variable nozzle system during brief periods of inverted flight; but supply for the constant speed drive system is uninterrupted regardless of flight attitude.

8–9. A priority system is maintained by the oil tank such that oil supply for the constant speed drive system is interrupted if less than 2.2 gallons of oil remains in the tank, and supply to the variable nozzle system is interrupted if less than 0.9 gallon remains. The remaining oil provides lubrication for the bearings, gears, and oil seals.

CAUTION

Oil supply for the CSD can be interrupted if tank level drops 14 pints.

8–10. **MAIN LUBE AND HYDRAULIC PUMP.** See figure 8–1. The main lube and hydraulic pump discharges oil, under pressure, to lubricate and cool the bearings, gears, and oil seals. The hydraulic element supplies oil for the variable nozzle system.

8–11. The main lube and hydraulic pump, which is on the right rear pad of the rear gearbox, is a positive displacement, dual element, rotary vane type pump. The no. 1 element (nearest the drive coupling) is the lube element; the no. 2 element is the hydraulic element. See table 8–1 for design features of the lube and hydraulic pump.

8–12. **LUBE AND HYDRAULIC FILTER.** See figure 8–1. The lube and hydraulic filter removes particles from the lube oil and the hydraulic oil prior to its distribution to the systems.

8–13. The lube and hydraulic filter, which is an assembly of two filter elements on a single filter body, is bolted on the discharge ports of the main lube and hydraulic pump. Each filter incorporates a check valve, to prevent oil flow during engine shutdown, and a shutoff valve which closes to prevent oil loss from the system when the filter element is removed. The elements are essentially the same but are not interchangeable. See table 8–1 for design features of the lube and hydraulic filter.

8–14. **PRESSURE TRANSMITTER RELIEF VALVE.** See figure 8–1. The pressure transmitter relief valve protects the oil pressure transmitter (a QEC component) from the high oil pressure that occurs during sub–zero starts.

8–15. The pressure transmitter relief valve is in the lube pressure sensing line and relieves to the lube inlet of the main lube pump.

8–16. **LUBE NOZZLES.** The lube nozzles direct a stream of oil onto the areas to be lubricated and cooled.

8–17. Lube nozzles may either be in the form of tubes that are connected to manifolds in the bearing areas and gearboxes or are made up of internal ports cast into the gearbox casing.

Table 8-1. Leading Particulars

Leading Particulars	Specifications
MAIN LUBE AND HYDRAULIC PUMP	
Rotation	CCW when viewed from the drive end
Shear section	
Main shaft	800 to 1000 in. lb.
Hydraulic element	200 to 300 in. lb.
Pumping capacity	
Lube element	11.8 gpm maximum
Hydraulic element	4.1 gpm maximum
Discharge pressure	
Lube element	40 to 60 psi above sump vent pressure (uninstalled)
Hydraulic element	70 to 110 psig.
LUBE AND HYDRAULIC FILTER	
Rated flow	
Lube element	12.5 gpm
Hydraulic element	3.9 gpm
Filtration capability	
Lube element	149 microns
Hydraulic element	46 microns
TRANSFER GEARBOX SCAVENGE PUMP	
Rotation	CW when viewed from the drive end
Shear section	400 to 500 in. lb.
Pumping capacity	
No. 1 element	11 gpm maximum
No. 2 element	2.7 gpm maximum
Rated speed	3798 RPM
Discharge pressure	70 to 140 psig
REAR GEARBOX SCAVENGE PUMP	
Rotation	CW when viewed from the drive end
Shear section	400 to 500 in. lb.
Pumping capacity	
No. 1 element	11 gpm maximum
No. 2 element	5.2 gpm maximum
No. 3 element	3.9 gpm maximum
Rated speed	3815 rpm
Discharge pressure	70 to 140 psig
NO. 3 BEARING SCAVENGE PUMP	
Rotation	CCW when viewed from the drive end
Shear section	80 in. lb.
Pumping capacity (each element)	3 gpm maximum
Rated speed	7685 rpm shaft speed. A 2.5 to 1 gear reduction is inside the pump.
Discharge pressure	70 to 140 psig
SCAVENGE OIL FILTER	
Rated flow	12 gpm
Filtration rating	46 microns

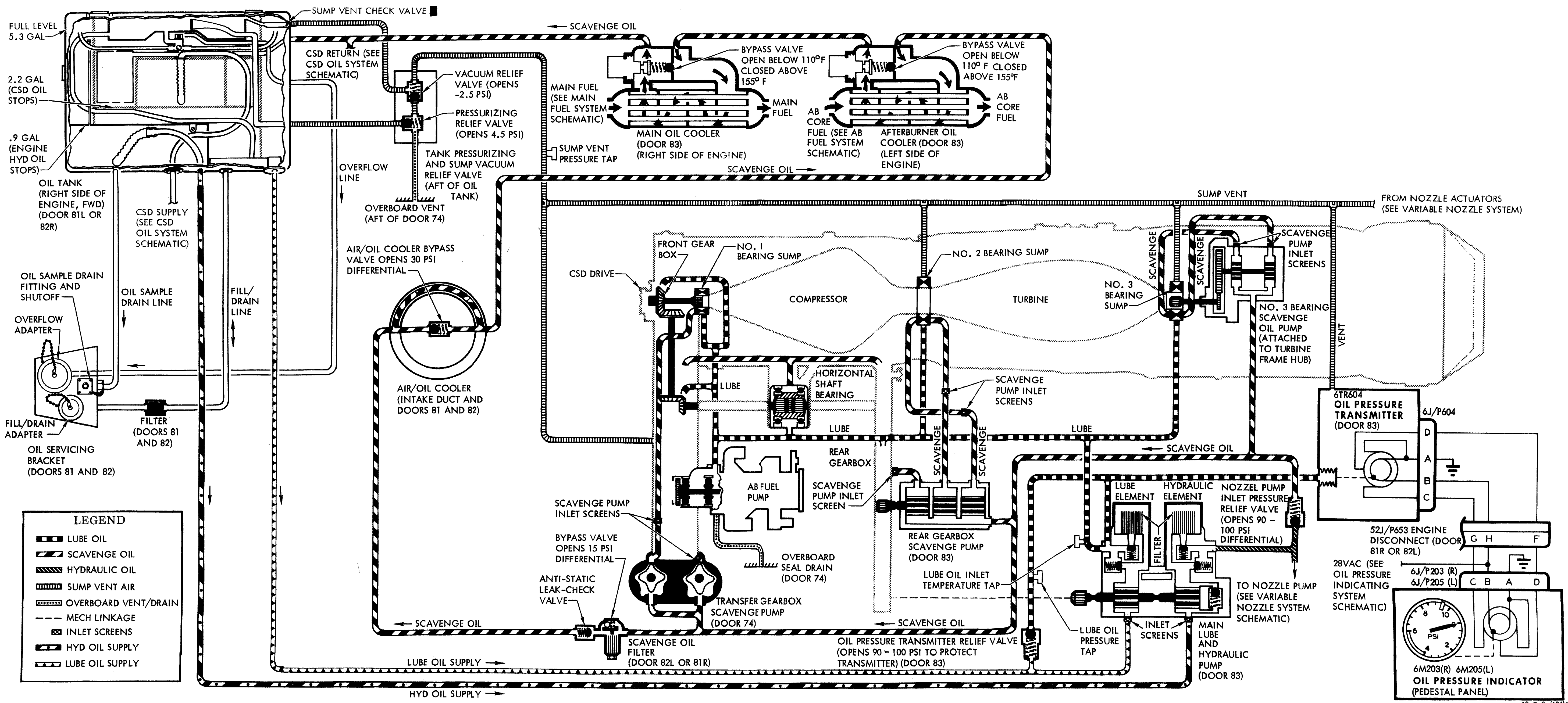


Figure 8-1. Lubrication System Schematic

Figure 8-1.

8–18. **OIL TANK FILL/DRAIN LINE FILTER.** The fill/drain line filter (a QEC component) prevents contamination of the engine oil tank during oil servicing. The filter is in the oil tank fill/drain line at the 5 o'clock position near the oil servicing bracket.

8–19. **TRANSFER GEARBOX SCAVENGE PUMP.** See figure 8–1. The transfer gearbox scavenge pump recovers oil from the transfer gearbox and the sump behind the no. 1 bearing.

8–20. The transfer gearbox scavenge pump, which is mounted on the bottom rear pad of the transfer gearbox, is a positive–displacement, two–element pump. An inlet screen in the gearbox, and one in the inlet line from the bearing sump, removes particles larger than 0.030 inch in diameter from the oil. The two elements discharge through a common port. See table 8–1 for detailed specifications of the transfer gearbox scavenge pump.

8–21. **REAR GEARBOX SCAVENGE PUMP.** See figure 8–1. The rear gearbox scavenge pump recovers oil from the rear gearbox and the climb and dive portions of the no. 2 bearing sump.

8–22. The rear gearbox scavenge pump, which is mounted on the bottom rear pad of the rear gearbox, is a positive–displacement, three–element pump. An inlet screen in the gearbox port, and one in each outlet fitting on the compressor rear frame removes particles larger than 0.030 inch in diameter from the oil. The three elements discharge through a common port.

8–23. **NO. 3 BEARING SCAVENGE PUMP.** See figure 8–1. The no. 3 bearing scavenge pump recovers oil from the no. 3 bearing sump.

8–24. The no. 3 bearing scavenge pump, which is mounted on the rear of the turbine frame hub, is a positive displacement, two–element pump. An inlet screen in each inlet port removes particles larger than 0.030 inch in diameter from the oil. The two elements discharge through a common outlet. See table 8–1 for detailed specifications of the no. 3 bearing scavenge pump.

8–25. **SCAVENGE OIL FILTER.** See figure 8–1. The scavenge oil filter removes contamination from the scavenge oil before it is returned to the oil tank for reuse.

8–26. The scavenge oil filter, which is at the 8 o'clock position on the compressor front casing, contains a cleanable filter element and a pressure relief valve. The pressure relief valve permits unfiltered oil to bypass the element should the pressure drop exceed 15 $\pm$1.5 psi.

8–27. **ANTI–STATIC LEAKAGE CHECK VALVE.** See figure 8–1. The anti–static leakage check valve prevents oil from returning to the gearboxes when the engine is shut down.

8–28. The anti–static leakage check valve is within the fitting in the discharge port of the scavenge oil filter. The valve permits oil to flow from the scavenge filter toward the oil tank but prevents reverse flow during engine inactivity.

8–29. **AIR OIL COOLER.** The air oil cooler is installed as an intake roll unit with the compressor inlet bellmouth. The air oil cooler assists the main and afterburner oil coolers in cooling of the combined CSD and engine lubrication systems.

8–30. **AIR OIL COOLER PRESSURE RELIEF VALVE.** The pressure relief valve is mounted to the air oil cooler at approximately the 10 o'clock position. Its function is to limit oil cooler differential pressure in the event of restricted flow through the cooler. Access is with the engine removed.

8–31. **AFTERBURNER OIL COOLER.** See figure 8–1. The afterburner oil cooler reduces the temperature of the scavenge oil when the engine is operating in afterburner.

8–32. The afterburner oil cooler, which is at the 9 o'clock position on the compressor rear casing, comprises an oil control section and oil passages which route the oil over fuel tubes. The fuel tubes contain small baffles which agitate the fuel against sides of the tubes.

8–33. An oil bypass valve separates the inlet and outlet chambers. The valve is opened by oil temperature and pressure differential.

8–34. **MAIN OIL COOLER.** See figure 8–1. The main oil cooler reduces the temperature of the scavenge oil, using main fuel flow as a coolant.

8–35. The main oil cooler, which is at the 4 o'clock position on the compressor rear casing, is identical to the afterburner oil cooler.

8–36. **TANK PRESSURIZING AND SUMP VACUUM RELIEF VALVE.** See figure 8–1. The tank pressurizing and sump vacuum relief valve regulates the air pressure in the oil tank and controls sump vent air to prevent oil venting and/or air deficiency in the bearing sumps and gearboxes.

8–37. The tank pressurizing and sump vacuum relief valve, which is at the 2 o'clock position on the compressor rear casing, comprises two separate valves. The tank pressurizing valve limits the amount that tank pressure can exceed engine bay pressure. The sump vacuum relief valve limits the amount that sump pressure can become negative relative to the outlet of the tank pressurizing valve (ambient).

8–38. **SUMP VENT CHECK VALVE.** The sump vent check valve allows air to enter the tank should sump pressure become greater than tank pressure.

8–39. The sump vent check valve is within the inlet fitting of the oil tank. It prevents tank air pressure and oil from flowing to the sumps.

OPERATION

8–40. **SEQUENCE OF OPERATION.**

8–41. **OIL TANK.** See figure 8–1. Oil supply for the lubrication system flows through a port, in the bottom of the tank. Inverted flight attitude interrupts the lube supply. Oil supply for the variable nozzle system is contained in a priority compartment within the oil tank. A flexible pickup within this compartment remains submerged regardless of the flight attitude; however, the capacity of the compartment is only large enough to maintain the oil supply during inverted flight for

approximately 30 seconds. The gravity valve in this compartment prevents the oil from exiting into the main tank during inverted flight operation. The hydraulic compartment inlet is high encugh to terminate oil supply for the variable nozzle system if the oil level drops below 0.9 gallons during level flight.

8–42. Oil supply for the constant speed drive system is taken from an area in the center of the tank. A flexible pickup, which is confined by perforated baffles, assures a continuous supply of oil for the constant speed drive system regardless of flight attitude. The tip of the pickup is unable to remain submerged when the oil level drops below 2.2 gallons during level flight so that the small amount of oil remaining in the tank is reserved for the variable nozzle and lubrication systems. Normal oil level is just beneath the plenum chamber when the aircraft is in a level attitude.

8–43. The scavenge oil, which is being returned to the tank, contains a large volume of air, which is removed by a deaerator within the tank. The air within the tank is regulated to produce a tank pressure that reduces oil foaming and at the same time provides a positive inlet pressure for the supply pumps. A plenum chamber, with interconnected piping and a master valve, accummulates the air and vents it overboard.

8–44. During level flight air is piped from the top of the tank, through the master valve, and to the plenum chamber by two tubes. During a climb or dive, a ball within the master valve closes the port leading from the tube that becomes submerged. When the aircraft returns to level attitude, the oil purged from the vent tubes drains back to the main tank through the inverted air vent tube. During inverted flight operation, the ball in the master valve covers the port to the plenum chamber from both air vent tubes; the air is then vented to the plenum chamber through the inverted air vent tube. To prevent the oil in the vent tubes from holding the ball of the master valve over the port leading to the plenum chamber when the engine is turned back over, a relief valve opens and vents the air to the plenum chamber.

8–45. The sump vent check valve in the tank prevents the tank from compression due to a rapid ambient pressure rise during a descent. It also provides a relief for an excessive sump air supply.

8–46. **MAIN LUBE AND HYDRAULIC PUMP.** See figure 8–1. Oil flows from the oil tank through two lines; a 24–mesh screen at each inlet port removes particles in excess of 0.030 inch in diameter from the oil. The pump discharges oil to the lube and hydraulic filters that are mounted on the outlet ports. A pressure relief valve bypasses the hydraulic element discharge to the inlet when the pressure difference exceeds 70 to 100 psi. This valve prevents the hydraulic element from producing excessive oil pressures in the nozzle hydraulic pump cavity.

8–47. **LUBE AND HYDRAULIC FILTER.** See figure 8–1. Oil from the lube element of the lube and hydraulic pump flows through the lube element of the filter, through the anti–static leak check valve in the filter body and out the outlet. If the filter element becomes clogged, causing a pressure drop of more than 25 $\pm$2 psi (35 psi for P7 Filter) to occur, the relief valve opens and permits unfiltered oil to flow to the outlet.

8–48. A restrictor fitting at the filter outlet provides an oil pressure tap. The restrictor orifice produces a pressure drop when a relief valve in the transmitter line is open, such as during cold weather starting when high oil viscosity causes excessively high oil pressure. This valve and orifice protects the oil pressure transmitter from receiving the actual oil pressure until oil viscosity and the resulting oil pressure decreases.

8–49. When the filter bowls are removed, a shutoff valve closes to prevent oil from draining from the oil tank. The filter bowl holds the shutoff valve open when the filter is assembled.

8–50. **PRESSURE TRANSMITTER RELIEF VALVE.** See figure 8–1. At sub–zero temperature, lube oil pressure is higher than normal due to the increased viscosity of the oil. The pressure relief valve opens and bypasses oil when the pressure exceeds 90 to 100 psi to protect the transmitter. A restricting orifice in the fitting on the lube filter limits the oil flow through the relief valve when it is open and causes a pressure drop. As the viscosity of the oil decreases, the oil pressure decreases and the pressure relief valve closes. The transmitter then measures actual lube pressure.

8–51. **LUBE NOZZLES.** The number of jets and the approximate flow of oil into the various areas is as follows:

Location	No. Of Jets	Nominal Flow In GPM at 35 psi and 70° F
Inlet gearbox	4	1.1
No. 1 bearing sump	2	0.4
Transfer gearbox	14	3.4
A/B fuel pump drive shaft	2	0.2
Horizontal shaft support bearing	1	0.2
Rear gearbox	4	1.4
No. 2 bearing area	4	2.4
No. 3 bearing area	3	1.9

8–52. **TRANSFER GEARBOX SCAVENGE PUMP** See figure 8–1. The no. 1 element, which is nearest the drive spline, consists of two internal gear assemblies in parallel which scavenge oil from the transfer gearbox during a dive or level flight attitude. The oil in the transfer gearbox includes the oil delivered to the front gearbox, the AB fuel pump, and to the horizontal shaft support bearing and rear gearbox during a dive attitude. The no. 2 element scavenges oil from the sump behind the no. 1 bearing. A tube, with its inlet port in the sump, passes through strut no. 4 of the front frame. A hose conducts the oil from this tube to the inlet of the scavenge pump. An inlet screen is installed in the reducer on the pump.

8–53. **REAR GEARBOX SCAVENGE PUMP.** See figure 8–1. The no. 1 element, which is nearest the drive spline, scavenges the oil from the rear gearbox during a climb or level flight attitude. The oil in the gearbox includes the oil ported through the nozzle hydraulic pump bleed port and the transfer gearbox and horizontal shaft support bearing during a climb. The no. 2 element scavenges oil from the rear portion of the no. 2 bearing sump; the no. 3 element scavenges oil from the front portion of the no. 2 bearing sump. An inlet screen in the pump mounting pad of the gearbox and one in each of the outlet fittings of the compressor rear frame remove particles in excess of 0.030 inches in diameter.

8–54. **NO. 3 BEARING SCAVENGE PUMP.** See figure 8–1. The no. 3 bearing pump is driven through a flexible shaft which splines into the turbine cooling air baffle. The no. 1 element, which is nearest the drive spline, scavenges oil from the front portion of the no. 3 bearing sump; the no. 2 element scavenges oil from the rear portion of the sump. The oil is discharged into a tube which conducts the oil from the turbine frame hub to the outer end of strut no. 4.

8–55. **SCAVENGE OIL FILTER.** See figure 8–1. Oil from the three scavenge pumps, and the replenishing supply returned from the nozzle hydraulic pump, enters around the outside of the element and flows through the screen to the central core. If the element becomes clogged to the extent that the pressure drop exceeds 15 $\pm$1.5 psi, the oil bypasses through the relief valve.

8–56. **AFTERBURNER OIL COOLER.** See figure 8–1. Scavenge oil flowing out of the cooler flows around a thermostat which holds the oil bypass valve open when oil temperature is below 110°F, since the oil does not require additional cooling. When oil temperature exceeds 155 $\pm$5°F, the valve is closed and the oil is routed through the cooler passages. The bypass valve spring permits the oil to bypass the cooler if the pressure drop across the cooler is 40 to 65 psi. Below 40 psi pressure drop, the bypass valve is completely closed, and at 65 psi pressure drop, the bypass valve is completely open.

8–57. **MAIN OIL COOLER.** See figure 8–1. The operation of the main oil cooler is the same as that of the afterburner oil cooler. Refer to paragraph 8–56.

8–58. **TANK PRESSURIZING AND SUMP VACUUM RELIEF VALVE.** See figure 8–1. The tank pressurizing valve vents air from the oil tank whenever the air pressure in the tank exceeds ambient by 4.5 $\pm$0.5 psi. Airflow through the valve produces a pressure drop so tank pressure is normally somewhat higher. The air supply to the tank is continuous, by the action of the scavenge pumps whose combined output is approximately 2 1/3 times the capacity of the main lube and hydraulic pump.

8–59. The withdrawal of air from the engine bearing sumps and gearboxes creates a deficiency of air in the system. The oil seals, with relatively high pressure 9th-stage air surrounding the sumps, permit some air to enter the sumps. The condition of the seals determines the amount of air provided in this manner. The remainder of the deficiency creates a negative pressure in the sumps (relative to the tank pressurizing valve outlet chamber). When sump pressure decreases to 1.5 $\pm$.5 psi below the tank pressurizing ambient sensing port, the sump vacuum relief valve permits air to flow into the sumps; therefore, the air vented from the oil tank may split some reentering the sumps, the remainder being vented to ambient.

8–60. If an excessive amount of air enters the sumps, such that the sump pressure becomes more positive than tank pressure, it is then directed into the tank. This is an abnormal condition and high oil consumption results.

8–61. **SUMP VENT CHECK VALVE.** During a rapid descent, when ambient air pressure increases more rapidly than tank pressure, air is ported through the sump vacuum relief valve to the sumps and the oil tank. Faulty oil seals, permitting an excessive amount of air to enter the sumps, also port air into the tank. Air pressure in the sumps must exceed tank pressure by approximately ¼ psi in order to open the valve.

THEORY OF OPERATION

8–62. GENERAL.

8–63. Oil flows from the oil tank to the main lube and hydraulic pump. See figure 8–1. Screens at the inlet ports of the pump prevent particles in excess of 0.030 inch in diameter from entering the pump. The pump contains two elements, one of which discharges oil into the lube filter element, the other discharges oil into the hydraulic filter element. The hydraulic element of the pump incorporates a relief valve to limit pump discharge pressure – the main element does not incorporate a relief valve. Oil supply to the hydraulic system is independent from the lube system.

8–64. The lube and hydraulic filter, which bolts onto the pump discharge ports, contains two elements, one for lube supply and the other for hydraulic supply. A fitting on the lube filter, downstream from the filter element, conducts oil pressure to the aircraft pressure transmitter for cockpit indication. A relief valve in the pressure sensing line prevents excessive pressure, such as occurs during cold weather starting when oil viscosity if high, from damaging the pressure transmitter. An orifice in the fitting on the filter produces a pressure drop in the sensing line when the relief valve is open.

8–65. From the lube element of the filter, the oil flows to the gearboxes and bearing sumps. Oil supply for the rear gearbox enters through a port on the right end of the gearbox housing. Oil enters through an orifice fitting on the side of the horizontal shaft support bearing housing. Oil enters the transfer gearbox through two ports on the rear casing, and it is piped to the drive shaft bearings of the afterburner fuel pump. The oil for the no. 1 bearing area and the front gearbox flows through a tube in strut no. 4 of the compressor front frame. Oil supply for the no. 2 bearing area flows through the inside tube in strut no. 5 of the compressor rear frame; and for the no. 3 bearing area it flows through a tube in strut no. 3 of the turbine frame.

8–66. From the hydraulic element of the filter, oil flows to the inlet of the nozzle pump. A pressure relief valve on a tee in this line relieves oil, which returns from the nozzle actuators when the nozzle is closing, to the scavenge system. For a description of the nozzle system, refer to paragraph 7–1.

8–67. The oil is scavenged from both the front and rear of each lubrication area to ensure complete scavenging during climb and dive attitudes, as well as during level flight. The flow path for each area is as follows:

a. Front gearbox and no. 1 bearing sump

Climb	Through a tube leading from behind no. 1 bearing, through strut no. 4 of the front frame, and into an external hose to the transfer gearbox scavenge pump.
Dive	Through the open portion of the bottom strut of the front frame and into the transfer gearbox.

b. Transfer gearbox.

Climb	Through the gearbox pressure equalization line and into the rear gearbox.
Dive	Into the transfer gearbox scavenge pump.

c. Horizontal shaft support bearing

Climb and dive	Into the gearbox pressure equalization line and into the transfer or rear gearbox.

d. Rear gearbox

Climb	Into the rear gearbox scavenge pump.
Dive	Through the gearbox pressure equalization line and into the transfer gearbox.

e. No. 2 bearing sump

Climb	Through the outer tube in strut no. 5 of the compressor rear frame and through external piping to the rear gearbox scavenge pump.
Dive	Through a tube in strut no. 6 of the compressor rear frame and through external piping to the rear gearbox scavenge pump.

f. No. 3 bearing sump

Climb and dive	Through internal piping to the no. 3 bearing scavenge pump and out a tube in strut no. 4 of the turbine frame.

8–68. Inlet screens at each scavenge pump inlet port prevent particles in excess of 0.03 inch in diameter from entering the pump elements. The output of the three scavenge pumps is combined and delivered to the scavenge oil filter, which removes contaminants from the oil before it is returned to the oil tank. An anti–leakage check valve at the outlet of the filter prevents the oil in the tank from returning to the sumps and gearboxes when the engine is shut down. From the scavenge filter, the oil is routed through the aircraft air–oil cooler and back to the A/B oil cooler and the main oil cooler of the engine to lower the scavenge oil temperature, and then it is piped back to the oil tank.

8–69. The bearing sumps fully surround the engine bearings. A carbon rubbing oil seal on each side of the no. 2 and no. 3 bearing sumps keeps the oil within the sump. A cooling cavity, which surrounds the sumps, isolate the sumps from the high temperature engine environment and maintains a high air pressure outside the sumps (relative to sump pressure), which pressure loads the oil seals against the race and minimizes oil leakage across the oil seals. Air from the 9th–stage air extraction manifold is piped to the cooling cavities. Labyrinth–type air seals confine the air to the cooling cavities.

8–70. Ninth–stage air is also piped to a chamber between the two rows of carbon segments of the no. 1 bearing oil seal. The segments nearest the bearing serve as an oil seal; the rear segments serve as an air seal.

8–71. If an oil seal (or seals) is defective, an excessive amount of 9th–stage air enters the sump (or sumps). The increased sump temperature, due to the 9th–stage air flowing into the sump, causes excessive oil consumption, particularly during flight. An excessive amount of air leakage into an individual sump may not necessarily upset the regulation for the combined sump vent pressure, but the excessive amount of air returning to the tank carries some oil overboard through the aircraft sump vent line.

8–72. The oil that is returned to the oil tank by the scavenge pumps is routed into a deaerator to remove the entrained air from the oil. The air pressure within the tank, resulting from this continuous supply of air, is regulated by the tank pressurizing valve to 4.5 $\pm$0.5 psi above ambient. Airflow through the valve creates an additional pressure drop, so tank pressure is maintained at a slightly higher value.

8–73. Some of the air that is discharged from the tank pressurizing valve flows through the open sump vacuum relief valve to make up for the air being evacuated from the sumps; the remainder of it is piped overboard by aircraft piping. If an obstruction occurs in the overboard vent line, or too great an airflow is being routed through the tank pressurizing valve (an excessive amount of air entering the combined sump) a pressure is created at the inlet to the sump vacuum relief valve which forces additional air into the sumps. This causes sump pressure, and consequently oil consumption, to increase. Proper functioning of the oil seals and the accessory drive seals, therefore, is imperative for satisfactory operation of the lube system.

8-74. The combined sump vent is connected to the tank pressurizing and sump vacuum relief valve. Individual sumps are vented as follows:

a. No. 1 bearing sump, which is interconnected to the transfer gearbox, by the hollow drive shaft and the open cavity through which it passes in the front frame, and to the rear gearbox, by the drive shaft housings and the pressure equalization line between the gearboxes, is vented through a port on the left end of the transfer gearbox.

b. No. 2 bearing sump is vented through the outer tube in strut no. 1 of the compressor rear frame.

c. No. 3 bearing sump is vented through a tube in strut no. 6 of the turbine frame.

TOOLS AND TEST EQUIPMENT

8-75. GENERAL.

8-76. In order to perform maintenance on the system or components, the special tools and test equipment listed in table 8-2 should be used. Alternate equipment with equal or greater range and accuracy than that in the Alternate Equipment column may be substituted. The listed tools and test equipment are for performing aircraft and shop maintenance procedures in this section of the manual.

Table 8-2. Tools and Test Equipment

Name	Identification No.	Alternate Equip. Range	Alternate Equip. Accuracy	Use
Pressure readout gage set	1C2995G3			To read engine pressures.
Oil servicing unit	PMU-29/E			Flushing for lube system contamination.
Torque wrench		0 to 1200 inch-pounds		Torque lube and hydraulic pump mounting nuts.
Torque wrench		0 to 600 inch-pounds		Torque fittings on rear gearbox scavenge pump.
Torque wrench		0 to 100 inch-pounds		Torque fittings on rear and transfer gearbox scavenge pumps.

AIRCRAFT MAINTENANCE

8-77. REPLACEMENT AND ADJUSTMENT.

WARNING

Engine synthetic hydraulic and lubrication oil (MIL-L-7808) is harmful to some substances. Be careful not to spill oil on electrical wiring, painted areas, rubber parts, or other units. Synthetic oil spilled on painted surfaces or on rubber components must be wiped off at once. Use a clean cloth saturated with aliphatic naphtha (TT-N-95). Prolonged contact with engine oil may irritate the skin and eyes. Wash hands with soap and water before touching any food. Hoses and seals made for use with petroleum oils must not be used with synthetic oil.

8-78. To remove and replace some of the lubrication system components the engine must first be removed from the aircraft. Reference is then made to T.O.2J-J79-46 Intermediate Maintenance, for removal and installation instructions of these components. The affected lubrication system components are as follows: oil tank afterburner oil cooler, main oil cooler, tank pressurizing and relief valve and sump vent check valve.

8-79. TRANSFER GEARBOX SCAVENGE PUMP REPLACEMENT. See figure 8-2.

8-80. Tools and Equipment.

Torque wrench, 0 to 100 inch-pounds
Torque wrench, 0 to 600 inch-pounds

8-81. Materials.

Lockwire, MS20995NC32

8-82. Removal.

a. Open door 74 L or R.

b. Remove the lockwire from hold-down bolts, jam nuts and fittings.

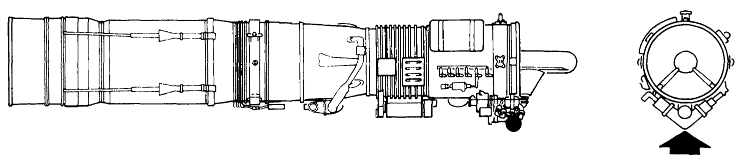
c. Remove clamps from the tube and oil hose connected to the elbow at the pump outlet port.

d. Disconnect the tube and oil hose connected to the elbow at the pump outlet port.

NOTE

The jam nut on the elbow must be held with a wrench while disconnecting the tube and oil hose to prevent the elbow from coming loose.

e. Disconnect the front frame scavenge tube, connected



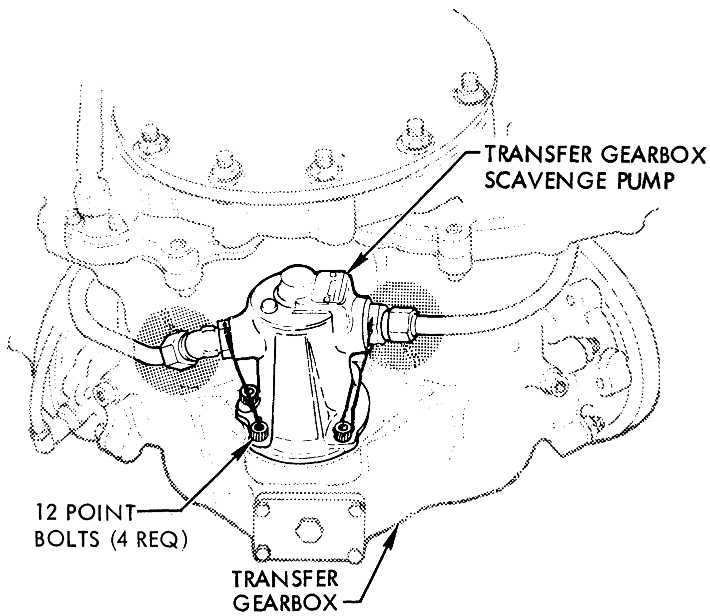


Figure 8-2. Transfer Gearbox Scavenge Pump Removal and Installation

to the union-reducer at the pump inlet port.

NOTE

The hex nut on the union-reducer must be held with a wrench while disconnecting the front frame scavenge tube to prevent the union-reducer from coming loose.

f. Remove the inlet screen from the union reducer and inspect it for chips.

g. Remove the four bolts and washers that secure the pump to the transfer gearbox.

h. Remove the transfer gearbox scavenge pump.

NOTE

If pump is to be replaced, remove elbow, union reducer, and all O-rings.

i. Remove and discard scavenge pump gasket.

8-83. **Installation.**

a. Install the union reducer together with new O-ring at scavenge pump inlet.

b. *Torque union reducer 360 to 400 inch-pounds and secure with lockwire.*

c. Install the elbow together with new O-ring at pump outlet port.

d. *Torque jam nut 270 to 300 inch-pounds and secure with lockwire.*

e. Install new scavenge pump gasket on pad of transfer gear box.

f. Fit scavenge pump to gearbox and secure with 4 bolts and washers.

g. *Torque bolts 55 to 70 inch-pounds and secure with lockwire.*

h. Install inlet screen into the union-reducer and connect the front frame scavenge tube to the union-reducer at the pump inlet port.

i. *Torque the fitting 450 to 550 inch-pounds and secure with lockwire.*

j. Connect the tube and oil hose to the elbow at the pump outlet port.

k. *Torque the fitting 270 to 300 inch-pounds and secure with lockwire.*

l. Install clamps on tube and oil hose connected to the elbow at the pump outlet port.

m. *Assure that the engine compartment is clear of foreign objects.*

n. *Close door 74 L or R.*

8-84. **TRANSFER GEARBOX OIL SCREEN REPLACEMENT.** See figure 8-3.

8-85. **Materials.**

Adhesive, synthetic rubber, EC776
Lockwire, MS20995NC32

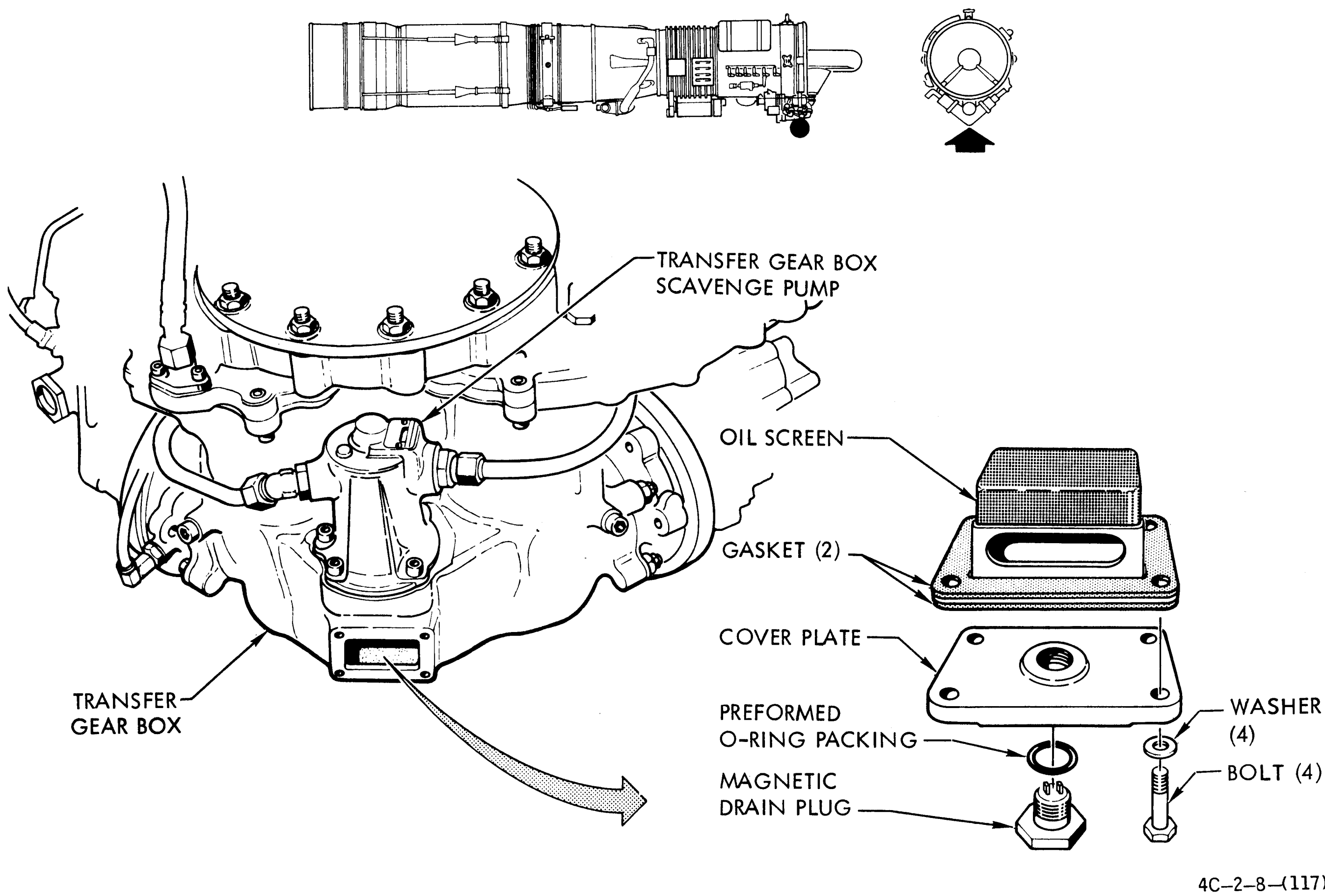


Figure 8-3. Transfer Gearbox Oil Screen Removal and Installation

8-86. **Removal.**

a. Open door 73 L or R.

b. Remove the drain plug and drain the oil into a suitable container.

c. Remove the four hold down bolts and remove the cover plate, oil screen, and two gaskets.

8-87. **Installation.**

NOTE

The oil screen should be installed with the window facing aft and be adjacent to the scavenge pump inlet.

a. Install two new gaskets one on each side of the oil screen mounting flange, and cement in place with synthetic rubber adhesive.

b. Install the oil screen, cover plate and four hold down bolts.

c. *Torque bolts 25 inch-pounds and lockwire.*

d. *Torque drain plug 60 to 80 inch—pounds and lockwire.*

e. *Close door 73 L or R.*

8-88. REAR GEARBOX SCAVENGE PUMP REPLACEMENT.

8-89. **Tools and Equipment.**

Torque wrench, 0 to 100 inch-pounds

8-90. **Materials.**

Gasket, 416B167P2
Seal (3 reqd), R302P01Y
Lockwire, MS20995NC32

8-91. **Removal.**

a. Open door 83 L or R.

b. Remove hose between inlet port of scavenge pump and fitting at strut no. 5 of compressor rear frame. Also remove tube hose between pump and fitting at strut no. 6. Remove filter screens from inside fittings at rear frame struts, and inspect for foreign material.

c. Remove bolts and washers that secure flanged connector to discharge port of pump.

d. Remove bolts, washers, and nuts that attach drain manifold to brackets on forward and rear sides of gearbox. Remove the nuts and washers that secure brackets to two lower studs on gearbox, and remove brackets. From forward side of gearbox unscrew two lower studs until they disengage from threads in scavenge pump flange. Remove nut and washer that secure pump to gearbox.

e. Remove scavenge pump and discard pump gasket.

f. Check inlet screen mounting pad of gearbox is clean.

8-92. **Installation.**

a. Insert filter screen into inlet port in pump mounting pad of gearbox. Insert filter screens into scavenge oil fittings at struts no. 5 and no. 6 of compressor rear frame.

b. Place a new gasket on pump mounting pad of gearbox. Install scavenge pump. Start threads of two lower studs into threads in pump mounting flange. Assemble locknut and washer onto outer mounting stud.

c. *Torque lower studs to 55 to 70 inch-pounds, and locknut to 55 to 70 inch-pounds.*

d. Assemble forward and rear mounting brackets for drain manifold onto two lower studs; secure brackets with washers and nuts.

e. *Torque locknuts 55 to 70 inch-pounds.*

f. Install bolts, washers, and nuts to secure manifold to brackets. *Torque 55 to 70 inch-pounds.*

g. Install seal and attach flanged connector to discharge port of pump. Install bolts and washers. *Torque bolts 24 to 27 inch-pounds.*

h. Install seals on inlet ports of pump. Install hoses between pump and fittings at struts no. 5 and no. 6 of compressor rear frame. Install bolts and washers.

i. *Torque bolts 24 to 27 inch-pounds and lockwire.*

j. *Close door 83 L or R.*

8-93. MAIN LUBE AND HYDRAULIC PUMP REPLACEMENT. See figure 8-4.

NOTE

For Filter Shut—off Valve Replacement, refer to T.O.2J—J79—46.

8-94. **Tools and Equipment.**

Torque wrench, 0 to 100 inch-pounds
Torque wrench, 0 to 600 inch-pounds
Torque wrench, 0 to 1200 inch-pounds

8-95. **Materials.**

Lockwire, MS20995NC32

8-96. **Removal.**

NOTE

Oil tank must be drained prior to removal of main lube pump.

a. Open door 83 L or R.

b. Remove four bolts from lube manifold supply flange and four bolts from hydraulic manifold supply flange.

c. Disconnect lube and hydraulic pressure lines from filter outlets.

d. Disconnect and remove lube pressure line to check valve.

e. Remove six nuts and washers from pump mounting flange and remove pump.

8-97. **Installation.**

NOTE

Prime all lines with MIL-L-7808 oil before installing.

a. Install new gasket, and mount lube and hydraulic pump on rear gearbox mounting pad. Install nuts and washers (6 places). *Torque nuts 190 to 250 inch-pounds.*

CAUTION

To prevent component failure conical screens must be installed so that they protrude into hydraulic and lube supply tubes, rather than into pump.

b. Install two new gaskets and one conical flanged type screen on each of the pump supply ports.

c. Install lube and hydraulic supply tubes on pump body with bolts and washers (8 places). *Torque lube tube bolts 55 to 70 inch-pounds and lockwire; torque hydraulic tube bolts 24 to 27 inch-pounds and lockwire.*

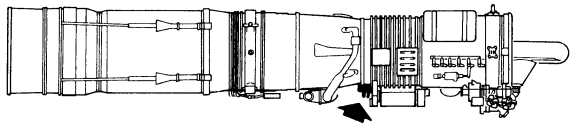
d. Install two new gaskets, and install lube and hydraulic filter manifold to pump body with bolts (8 places). *Torque bolts 24 to 27 inch-pounds and lockwire.*

e. Install lube discharge line upper end to check valve. *Torque line connector nut 270 to 300 inch-pounds and lockwire.*

f. Install lube discharge line lower end to lube and hydraulic filter manifold. *Torque connector nut 135 to 150 inch-pounds and lockwire.*

g. Install lube oil pressure line to reducer on manifold. *Torque line connector nut 650 to 770 inch-pounds and lockwire.*

h. Install hydraulic oil pressure line to 90° elbow on



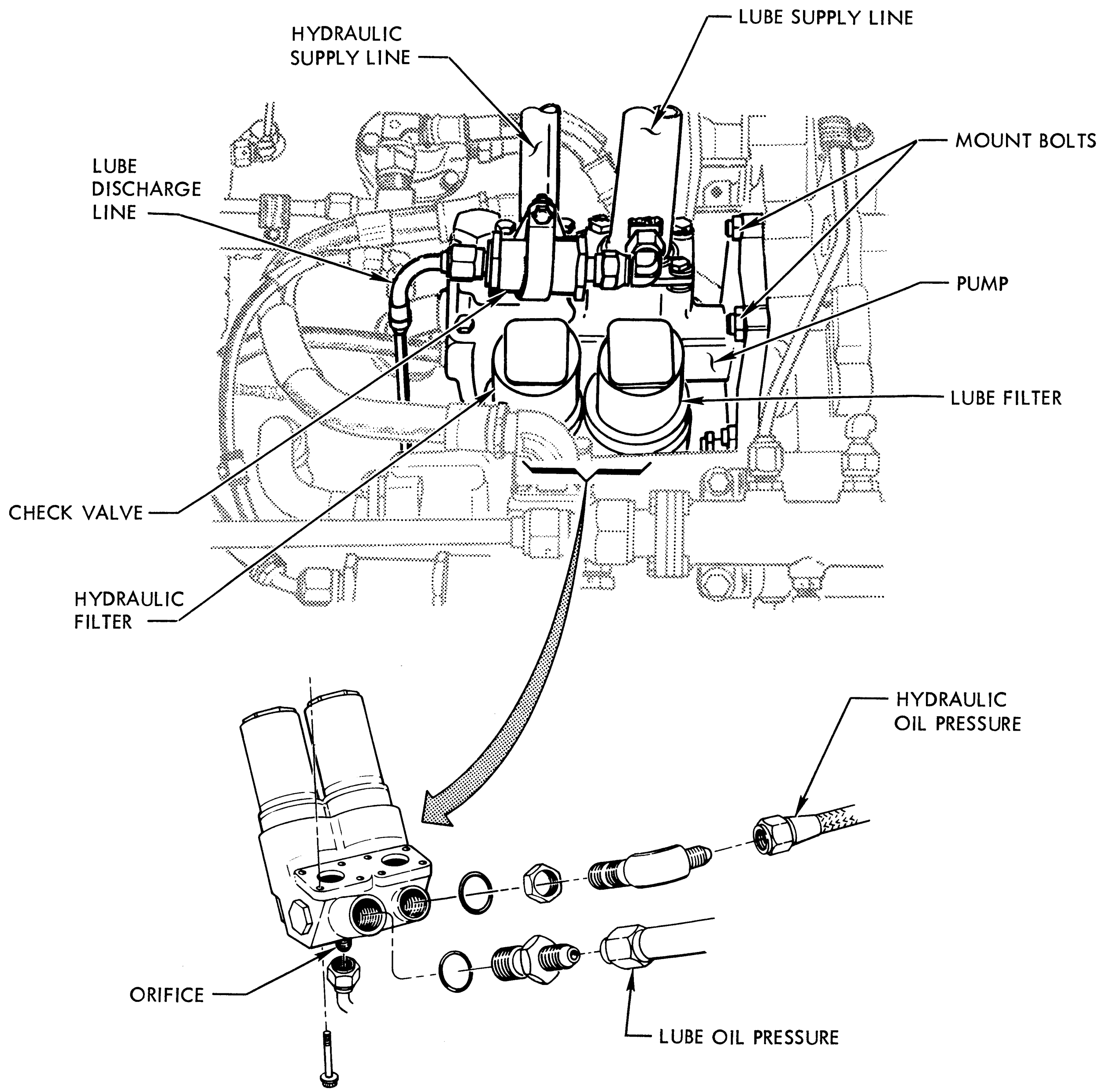


Figure 8-4. Main Lube and Hydraulic Pump Removal and Installation

manifold. *Torque line connector nut 270 to 300 inch–pounds and lockwire.*

i. Fill oil tank.

j. *Close door 83L or R.*

8–98. **FILL/DRAIN LINE FILTER REPLACEMENT.**

8–99. **Materials.**

Lockwire, MS20995NC32

8–100. **Removal.**

a. Open door 81L or 82R.

b. Drain oil tank by disconnecting hose on tank side of fill line filter.

c. Remove clamp from around filter body.

d. Disconnect hose from oil in side of filter.

8–101. **Installation.** See figure 8–4.

a. *Connect hose to oil side of filter assembly, assure direction of flow arrow on filter is toward oil tank.*

b. Attach hose to oil tank side of filter.

c. *Lockwire all fittings.*

d. Attach clamp to filter body.

e. Service oil tank. Refer to paragraph 8–120.

f. *Secure door 81L or 82R.*

8–102. **OIL PRESSURE TRANSMITTER REPLACEMENT.** Refer to T.O.1F–4C–2–11 for oil pressure transmitter removal and installation instructions.

8–103. CLEANING, DRAINING, AND LUBRICATION.

8–104. **CLEANING.**

NOTE

In addition to the filter cleaning instructions contained herein, refer to T.O.9H3–1–1 and comply accordingly.

8–105. **Lube and Hydraulic Oil Filter.** See figure 8–5.

8–106. Tools and Equipment.

Ultrasonic cleaning unit
Torque wrench, 0 to 100 inch–pounds

8–107. Materials.

Solvent, dry cleaning, P–D–680
Lockwire, MS20995NC32
Petrolatum, VV–P–236

8–108. Disassembly.

a. Remove lockwire, and remove filter bowl and element.

b. Remove filter element from bowl.

c. Remove O–rings (1 each) from inside element and discard.

8–109. Cleaning.

a. Before cleaning elements, cover ends with suitable fixtures to prevent contaminants from entering interior of filter.

b. Clean filter elements and bowls using cleaning solvent P–D–680 or other suitable cleaner and a brush that has soft bristles longer than depth of pleats in filter element.

c. The preferred method of cleaning is ultrasonic cleaning if equipment is available. Clean filters for five minutes at room temperature using trichlorethylene (O–T–634A) or equivalent. Position elements horizontally in cleaning tank and rotate 90° after each minute of cleaning. Back flush if possible.

d. Shake or blow excess solvent from filter element.

CAUTION

Air pressure must not exceed 40 psig maximum to prevent filter element damage.

8–110. Inspection.

a. Inspect filter element for tears, buckling, obstructions, and residual contamination.

b. Inspect seal seating surfaces for burrs.

8–111. Assembly.

a. Install new O–rings.

CAUTION

O–rings are not interchangeable. Improper installation will cause filter malfunction.

NOTE

To facilitate installation of O–rings, coat lightly with petrolatum.

b. If shutoff valve leaks during filter servicing or O–ring in filter head seems to have been damaged, replace filter assembly.

NOTE

Filter bowls are interchangeable; however diameters of elements are different to prevent improper assembly. Lube element is larger than hydraulic element.

c. Insert filter element into bowl.

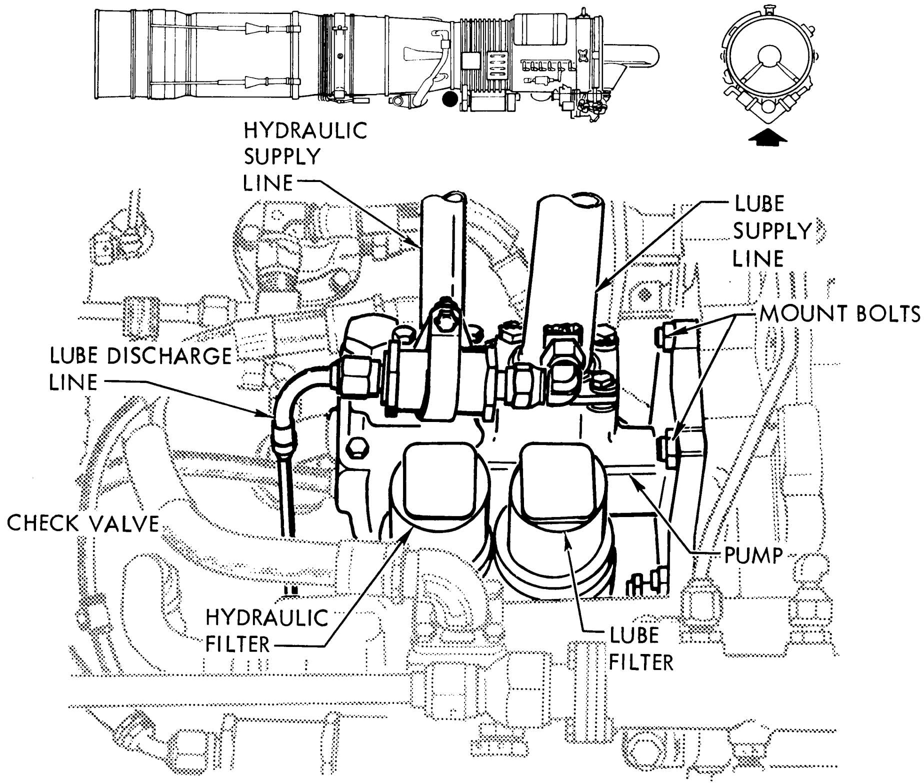
d. Push bowl and element into filter body until bowl contacts body.

e. Screw bowl into body. *Torque bowl 60 to 180 inch–pounds.*

f. *Secure bowls together with lockwire.*

NOTE

Check assembled filter assembly for leaks during engine operation.



NOTE

O-RING AND PLASTIC SEAL ARE HIDDEN BY SHUTOFF VALVE WHEN FILTER BOWL IS REMOVED

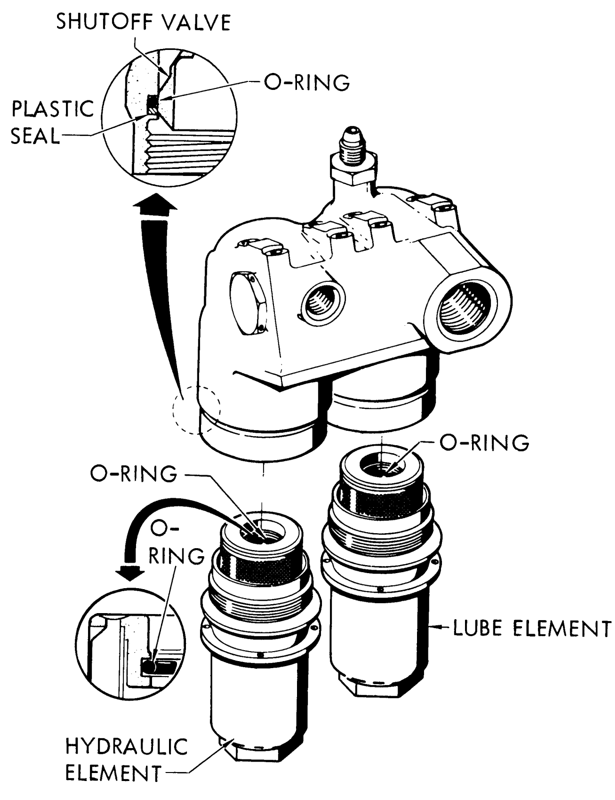


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Figure 8-5. Lube and Hydraulic Oil Filter

8–112. **Scavenge Oil Filter.** See figure 8–6.

8–113. Tools and Equipment.

Ultrasonic cleaning unit (optional)
Torque wrench, 0 to 100 inch–pounds

8–114. Materials.

Solvent, dry cleaning, P–D–680
Lockwire, MS20995NC32
Petrolatum, VV–P–236

8–115. Disassembly.

a. Remove drain plug and allow filter bowl to drain.

b. Unscrew filter bowl and remove.

c. Depress spring clips on filter element and remove from bowl.

d. Remove and discard O–rings (3) and plastic seal ring.

8–116. Cleaning.

a. Before cleaning element, cover end with a suitable fixture to prevent contaminant from entering interior of filter.

b. Clean filter element and bowl using cleaning solvent P–D–680 or other suitable cleaner and a brush that has soft bristles longer than depth of pleats in filter element.

c. A preferred method of cleaning is ultrasonic cleaning if equipment is available. Clean filter for five minutes at room temperature using trichlorethylene (O–T–634A) or equivalent. Position element horizontally in cleaning tank and rotate 90° after each minute of cleaning. Back flush if possible.

CAUTION

Air pressure must not exceed 40 psig maximum to prevent filter element damage.

d. Shake or blow excess solvent from filter element.

8–117. Inspection.

a. Inspect filter element for tears, buckling, and obstructions and residual contamination.

b. Inspect snap spring fingers for cracks, warpage, or missing piece.

c. Inspect seal surfaces for burrs.

8–118. Assembly.

NOTE

To facilitate installation of O–rings, coat lightly with petrolatum.

a. Install new O–rings.

b. Insert filter element into filter bowl.

c. Engage snap spring fingers.

d. Screw bowl into filter head.

e. *Torque bowl 55 to 65 inch–pounds and secure with lockwire.*

f. Install drain plug.

g. *Torque plug 55 to 65 inch pounds and secure with lockwire.*

h. *Check assembled filter for leaks d ng engine operation. Refer to paragraph 2–54.*

i. Check aircraft wire bundles for chafinց, security, and proper installation after scavenge oil filter change cleaning.

8–119. **Fill Drain Line Filter.** It is recommended that fill drain line filter element not be cleaned. Replace entire filter assembly.

8-120. ENGINE OIL SERVICING. See figure 8—7.

8-120A. **Tools and Equipment.**

Unit, oil servicing
Strut, aux air door

8-120B. **Materials.**

Lubricating oil, MIL—L—7808

8-121. **Procedure.**

NOTE

Oil level in tank is affected by attitude of aircraft.

a. Park aircraft on level ground.

b. Open doors 81 L or R.

WARNING

To prevent injury, assure auxiliary air door safety struts are installed on doors 81 L or R.

c. Install auxiliary air door safety struts on doors 81 L or R.

NOTE

Service engine oil tanks as soon as possible but not to exceed 30 minutes after shutdown. If engine is not serviced within 30 minutes, motor engine in pneumatic mode for 1 minute prior to servicing.

Prior to servicing engine oil tank assure oil servicing unit is filled with engine lubricating oil.

Check valve should be installed in oil servicing unit supply line to prevent inadvertent draining of oil tank.

d. Remove pressure caps from fill/drain and overflow adapters on engine oil servicing bracket.

e. Clean oil, dirt or other foreign matter from adapters and hose adapters.

f. Position oil servicing unit under door 81 L or R and place stabilization legs down.

g. Disconnect supply nozzle from servicing unit and connect it to fill/drain adapter (small adapter) on servicing bracket.

h. Disconnect overflow nozzle from servicing unit and connect to overflow adapter on bracket.

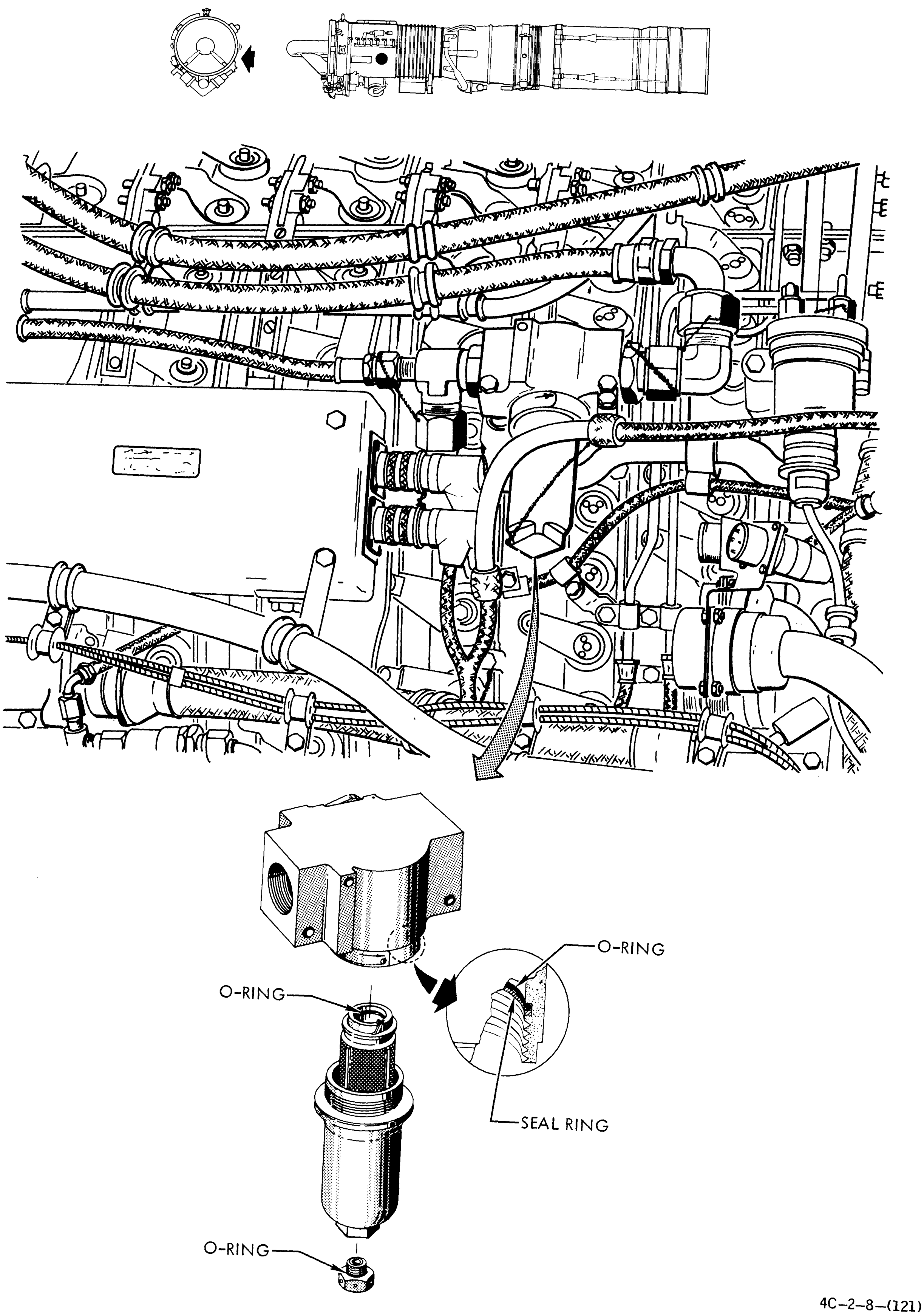


Figure 8-6. Scavenge Oil Filter

i. Set overflow tank sight gage pointer to level of oil in tank.

j. Open bypass valve and close ball valve.

k. Operate pump handle to build up pressure 22 psi.

CAUTION

Turn volume indicator counterclockwise when setting indicator. Turning indicator in clockwise direction will result in improper indication and can damage indicator.

l. When pressure reaches 22 psi, reset flow meter to zero by turning volume indicator counterclockwise.

m. Close bypass valve and open ball valve to route oil to engine tank.

n. Pump oil into engine tank until oil is observed, through sight gage in return line, returning to servicing unit.

CAUTION

If check valve is not installed in supply line, close ball valve immediately to prevent oil from draining back into servicing unit.

o. *Close ball valve and disconnect supply line from fill/drain adapter on servicing bracket. Install pressure cap on adapter.*

p. *Allow excess oil to drain from hoses to servicing unit, and disconnect return line from adapter. Install pressure cap on adapter.*

q. Calculate engine oil consumption by subtracting quantity of oil drained from quantity required to replenish engine oil tank as indicated by servicing unit volume indicator.

r. Record engine oil consumption in appropriate engine log.

8-122. Engine Oil Level Check. Existing method of checking oil level is to service the oil tank according to figure 8-7 after each flight and assure that it is full.

8-123. Oil Consumption. The oil consumption should not exceed 1.0 pint per hour. However, because of the inaccuracies of the oil servicing equipment (indicator on oil servicing unit measures in quart increments) an indicated oil consumption of 2 pints per hour is allowed for flights of 2 hours or less duration.

NOTE

If oil consumption exceeds normal amount, motor engine for 1 minute. Reservice oil tank noting additional amount required to fill tank and amount drained from tank overflow.

8-124. OIL ANALYSIS SAMPLE AFTER T O 1F-4-716. See figure 8-8.

a. Through door 81 L or R

b. Open drain valve and drain approximately one pint of oil into a container.

c. Close drain valve.

d. Take spectrometric analysis oil sample. Refer to TO 42B2-1-9.

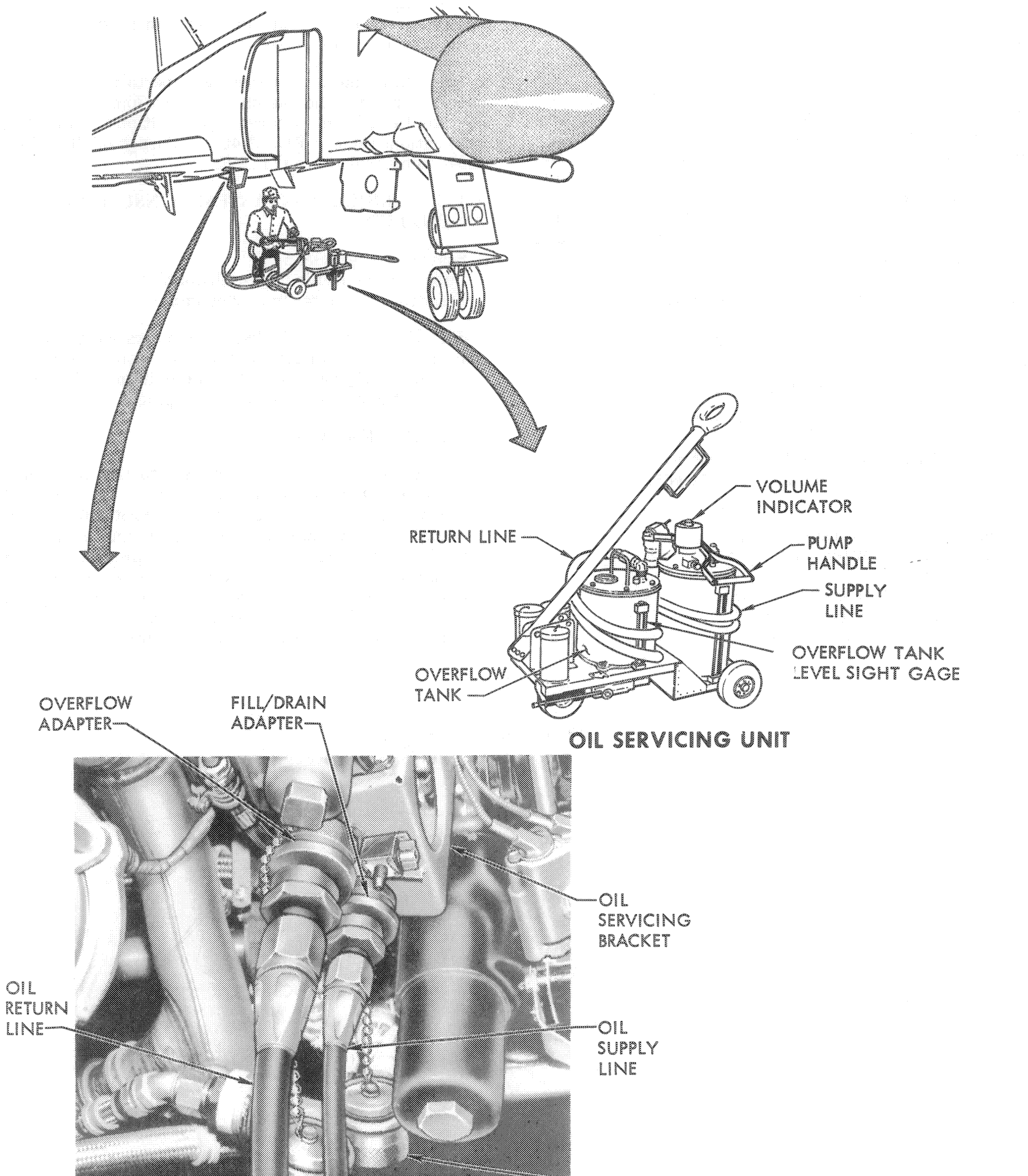


Figure 8-7. Oil Servicing

8-125. DRAINING.

8-126. Oil Tank Draining. See figure 8-8.

NOTE

Always disconnect fill/drain line on tank side of filter to drain oil tank.

Draining of the oil tank is accomplished through the fill/drain line. On engines with the fill drain line filter installed, drain the tank by disconnecting the fill/drain line on the tank side of the filter. It is possible to drain the oil tank through the filter and oil servicing bracket fitting, providing the engine oil is warm, but any foreign matter is trapped on the tank side of the filter during reservicing. To completely drain the oil tank, the hydraulic compartment within the oil tank must be drained independently. This may be accomplished by disconnecting the engine hydraulic pump supply line or by removing the cap from the hydraulic compartment drain fitting on the bottom of the oil tank.

SHOP MAINTENANCE

8-127. MAINTENANCE PROCEDURES.

8-128. LUBRICATION SYSTEM GOVERNMENT FURNISHED AERONAUTICAL EQUIPMENT.

Oil tank
Main lube and hydraulic pump
Pressure transmitter relief valve
Lube nozzles
Transfer gearbox scavenge pump
Rear gearbox scavenge pump
No. 3 bearing scavenge pump
Scavenge oil filter
Anti-static leakage check valve
Afterburner oil cooler
Main oil cooler
Tank pressurizing and sump vacuum relief valve
Sump vent check valve

8-129. Maintenance procedures pertaining to the government furnished aeronautical equipment (G.F.A.E.) are contained in separate publications. For these publications refer to T.O.1F-4C-01. Paragraph 8-128 lists those items which are G.F.A.E.

8-130. LUBRICATION SYSTEM CONSUMABLE ASSEMBLIES.

Scavenge filter (cleanable)
Lube and hydraulic filters (cleanable)
Fill/drain line filter (non-cleanable)

8-131. Paragraph 8-130 lists assemblies which are not considered economically repairable. Component spare parts are not provisioned for these items. If repair is required, the assembly should be replaced.

8-132. PACKAGING.

8-133. Components to be forwarded to the next higher level of maintenance for repairs, test, or check must be cleaned, preserved and packaged for protection against physical and mechanical damage during subsequent handling, shipping and storage. For preservation and packaging methods referred to herein, refer to AFP 71-4 volumes 1 and 2. Components packed for forwarding must further be identified, marked and documented in accordance with applicable Air Force procedures.

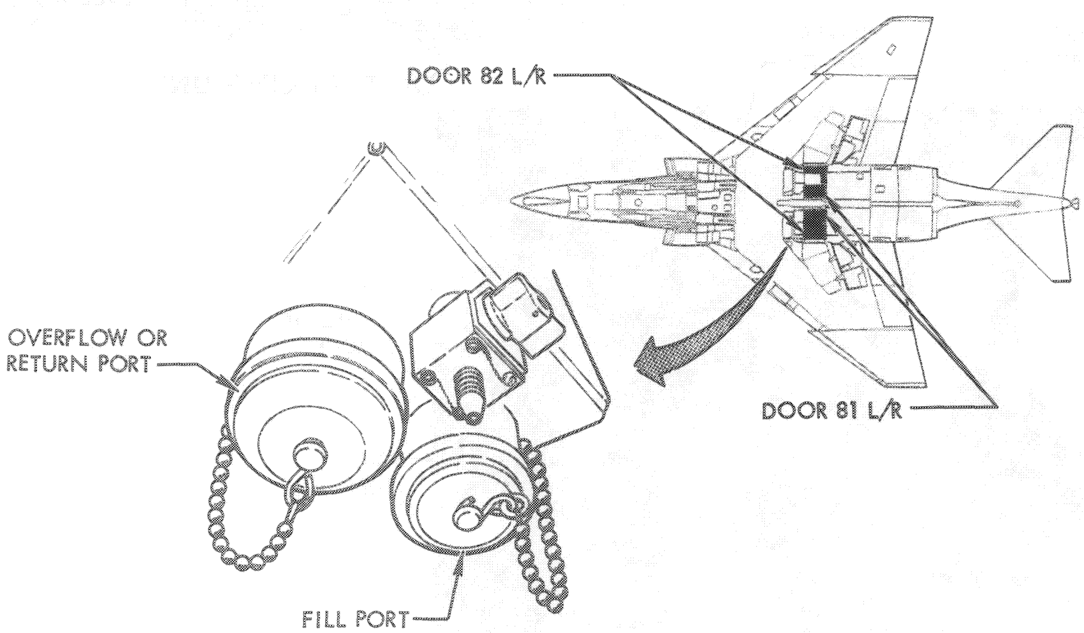


Figure 8-8. Oil Sample Drain Line

8-134. AIR OIL COOLER.

8-135. Refer to T.O.1F-4C-10 for shop maintenance of the air cooler.

8-136. AIR OIL COOLER RELIEF VALVE.

8-137. Refer to T.O.1F-4C-10 for shop maintenance of the air cooler relief valve.

SECTION IX

VARIABLE VANE SYSTEM

DESCRIPTION

9-1. SYSTEM DESCRIPTION.

9-2. The variable vane system, figure 9-1, maintains satisfactory compressor performance over a wide range of operating conditions. The system varies the angle of the inlet guide vanes and the first six stages of variable vanes so as to aerodynamically match the low pressure stages of compression with the high pressure stages. This variation of vane position changes the effective angle at which air flows across the rotor blades. The angle determines the compression characteristics for any particular stage of compression. By varying the variable vane position in accordance with a predetermined schedule, and as a function of those conditions affecting compressor performance (compressor inlet temperature and engine speed), the critical low pressure stages are automatically realigned or rematched to maintain satisfactory airflow and compressor performance (CDP) during all engine operating conditions within the physical limitations of the system.

9-3. The relative airflow across the variable vanes depends upon the speed of the rotor and the temperature of the air (density). High air temperature decreases the air density so the vanes cannot be scheduled as far open at a selected speed within their scheduling range. The calculation of compressor performance is, therefore, based on the relationship of the operating condition to a standard day temperature. This is known as corrected engine speed. A higher RPM is necessary during high inlet temperature operation to produce the airflow (corrected engine speed) the compressor would deliver at 60°F. The vanes are scheduled between 63 percent and 95 percent corrected engine speed. Below 63 percent the vanes are closed; above 95 percent they are open.

9-4. COMPONENTS DESCRIPTION.

9-5. The variable vane actuators are the only components of the system that are not covered in the descriptions of other systems.

9-6. **VARIABLE VANE ACTUATOR.** The variable vane actuators position the variable vanes as a function of fuel pressure signals from the main fuel control.

9-7. The variable vane actuators are double acting, uncushioned hydraulic actuators. Engine fuel acts as both lubricant and actuating medium. The two actuators are on the front compressor casing at the 4 and 10 o'clock positions. See table 9-1 for actuator design features.

Table 9-1. Leading Particulars

Operating fluids	MIL-T-5624, grade JP -4
Stroke	3.7 inches (maximum) 3.2 inches (minimum)
Pressure ratings	1000 psi continuous operating pressure 1500 psi maximum operating pressure
Load ratings	1000 pounds in compression and tension
Cooling fluid flow	700 cc to 1300 cc per minute of JP-4 at 100°F with a pressure differential of 100 psi across piston

OPERATION

9-8. GENERAL.

9-9. The variable vanes are positioned by two hydraulic actuators which are actuated by fuel pressure from the main fuel control. Within the main fuel control are located a variable vane scheduling cam, which is positioned by engine speed and compressor inlet temperature signals; a variable vane feedback mechanism, which transmits a vane position signal to the control; and a variable vane scheduling valve, which is positioned as a result of the comparison of the scheduling cam position and the feedback signal.

9-10. Changes in engine speed rotate the scheduling cam, while changes in CIT translate the cam. Movement of the cam repositions the scheduling valve, which ports high pressure fuel (main fuel pump discharge pressure) to either the rod end (to open) or head end (to close) position of the vane actuators and vents the other end to the main fuel control case. The vane actuating linkage mechanically transmits the actuator movement to the variable vanes and inlet guide vanes.

9-11. A flexible cable attached to the linkage transmits a feedback signal to the main fuel control. The feedback mechanism in the control repositions the pilot valve to terminate the actuator signal when the vanes reach the scheduled position.

9-12. The variable vane systems are combined and controlled as a single system. The inlet guide vanes throttle and direct the airflow for the first stage rotor blades. By limiting airflow at lower engine speeds, the power requirements of the compressor are kept low and the turbine section, with the energy available to it, is able to provide an acceptable acceleration. As engine speed and airflow increase, the turbine section becomes more effective and is able to provide additional power to the compressor.

9-13. When airflow velocity is reduced, however, air strikes the compressor blades at a greater angle. If this angle becomes too great, the flow pattern is interrupted and compressor stall results. The function of the variable vanes is to maintain the velocity of the air and the angle that it strikes the blades within acceptable limits for low airflow conditions, and to permit high airflow with a minimum of restriction.

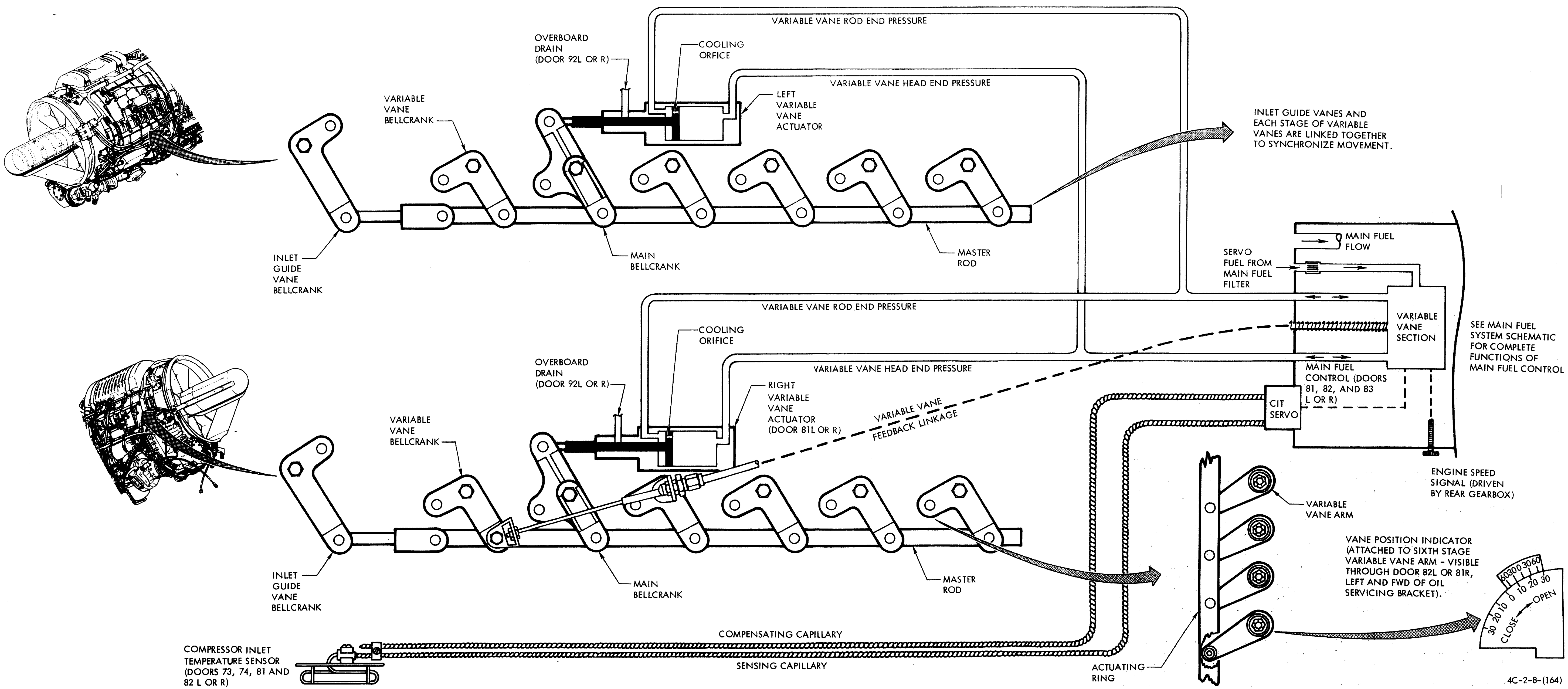


Figure 9-1. Variable Vane System Schematic

Figure 9-1.

9-14. The actuating linkage moves the inlet guide vanes and the six variable vane stages varying amounts. The second through the fifth stages move through an arc from 16°45′ closed to 19°30′ open.

9-15. COMPONENTS.

9-16. **VARIABLE VANE ACTUATOR.** Fuel pressure applied to the head end of the actuators extends the actuator rods, closing the variable vanes. Pressure applied to the rod ends of the actuators opens the vanes. A drain line carries leakage through the upstream rod seal to the engine drain manifold. A bleed orifice in the actuator piston permits fuel to flow across the piston for cooling and actuator stability during engine operation.

TOOLS AND TEST EQUIPMENT

9-17. GENERAL.

9-18. To perform maintenance on the system or components, the special tools and test equipment listed in table 9-2 should be used. Alternate equipment with equal or greater range and accuracy than that in the Alternate Equipment column may be substituted. The listed tools and test equipment are for performing aircraft and shop maintenance procedures in this ection of the manual.

Table 9-2. Tools and Test Equipment

Name	Identification No.	Alternate Equip. Range	Alternate Equip. Accuracy	Use
Tester Flight Line	1C2994G2A			To give a remote indication of variable vane angle during engine operation.
Tester, inlet guide vane	1C3568G1			For functional testing of variable vanes.
Rod, IGV transmitter attaching	Local Manufacture, see figure 2-17			For attaching IGV transmitter to QEC engine.
Wrench, torque		0 to 600 inch -pounds		

AIRCRAFT MAINTENANCE

9-19. REMOVAL AND INSTALLATION.

9-20. **VARIABLE VANE ACTUATOR.** See figure 9-2.

9-21. **Tools and Equipment.**

Tester, inlet guide vane, 1C3568G1
Wrench, torque, 0 to 600 inch-pounds

9-22. **Materials.**

Lockwire, MS20995NC32

9-23. **Manpower Requirement.**

a. Two men required.

9-24. **Removal.**

WARNING

To prevent injury to personnel, make sure safety struts are installed on door 81L and R actuators.

a. Open door 22 and disconnect actuator from door 81L or open door 82R.

b. Visually make sure engine fuel shutoff valve indicator in door 22 reads closed. If valve indicator reads open, perform steps f thru k of paragraph 13-43.

c. If variable vane actuator is being removed from right engine, remove low pressure fuel filter. Refer to paragraph 5-46. If variable vane actuator is being removed from left engine, remove inlet fuel disconnect assembly. Refer to paragraph 13-77.

d. Remove cap, seal, and clamp from engine fuel manifold and install on keel fuel flange.

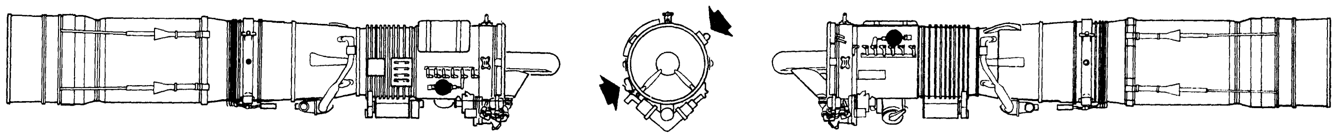
CAUTION

Cover exposed opening of low pressure boost pump to prevent impact damage and FOD.

e. Disconnect head end, rod end and drain hoses from actuator.

f. Remove hose fittings from actuator.

g. Disconnect rod end bearing from main bellcrank.



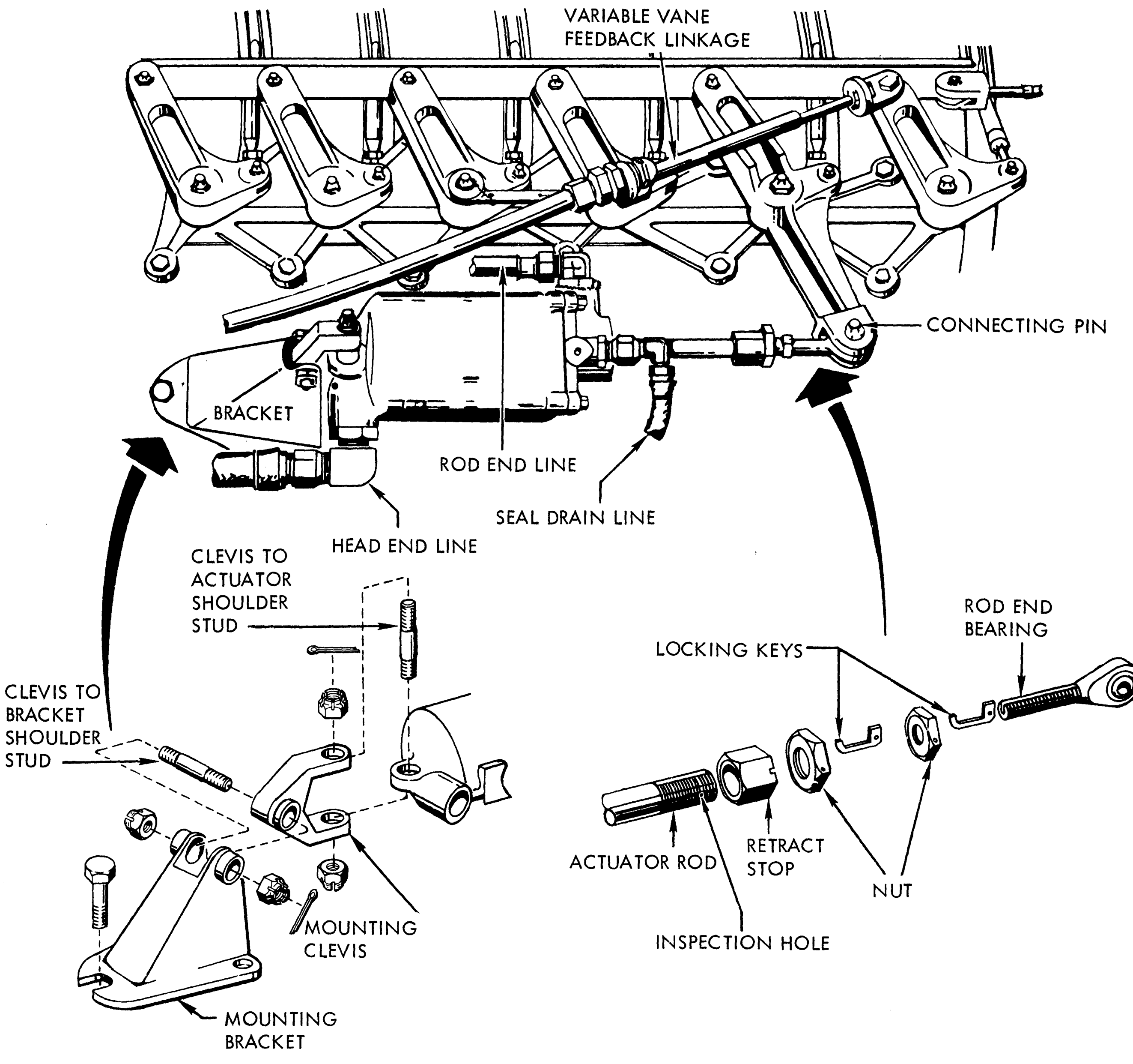


Figure 9-2. Variable Vane Actuator Removal and Installation

h. Remove engine clevis to bracket shoulder stud.

i. Remove actuator from engine.

j. Remove mounting clevis from actuator.

9-25. **Installation.**

CAUTION

In order to satisfactorily complete this procedure, rod end bearing, locking keys, locknuts and retract stop of removed actuator can not be disturbed until step a is complete.

NOTE

This procedure is for installation of right variable vane actuator when actuator system and removed actuator are known to have been properly adjusted.

a. Immediately after removing actuator being replaced perform following:

(1) Manually pull actuator rod from actuator until piston bottoms against its internal stops.

(2) Measure distance from forward face of actuator to rear face of retract stop. Record this measurement.

(3) Measure distance from forward face of actuator to center of hole running through rod end bearing. Record this measurement.

(4) Remove actuator.

b. Before placing new actuator on engine:

(1) Complete its assembly including retract stop, locking key, locknuts, and rod end bearing.

(2) Adjust retract stops as follows:

(a) Manually pull actuator rod from actuator until piston bottoms against its internal stops.

(b) Loosen retract stop locknut.

(c) Disengage locking key from stop.

(d) Adjust retract stop so that distance between rear face of retract stop and forward face of the actuator is the same as the measurement recorded in step a(2).

(e) Tighten locknut finger tight.

NOTE

Guide locking key into slot in stop when tightening locknut.

(f) *Recheck distance and readjust if necessary.*

(g) *Torque locknut 125 to 150 inch-pounds and lockwire.*

(3) Adjust rod end bearing as follows:

(a) Manually pull actuator rod from actuator until piston bottoms against its internal stops.

(b) Loosen locknut.

(c) Disengage locking key from slot in end of actuator rod.

(d) Adjust rod end bearing so that distance between front face of actuator and center of hole that runs through bearing is same as measurement in step a(3).

(e) Engage locking key in one of slots in end of actuator rod.

(f) Tighten locknut finger tight.

(g) *Recheck distance and readjust if necessary.*

(h) *Torque locknut 125 to 150 inch-pounds and lockwire.*

c. Install actuator on engine as follows:

(1) Install mounting clevis on replacement actuator.

(2) Move mounting clevis in bracket and install clevis on bracket shoulder stud.

(3) Connect rod end bearing to main bellcrank. Tighten and install cotter pin.

(4) Install actuator fittings with seals, torque rod end port jam nut 270 to 300 inch-pounds, torque head end port jam nut 360 to 400 inch-pounds, lockwire.

(5) *Connect head—end, rod—end, and drain hoses to fittings. Torque steel head—end and rod—end fittings 450 to 550 inch—pounds. Torque aluminum head—end and rod—end fittings 150 to 250 inch—pounds. Torque drain hose fittings 135 to 150 inch—pounds.*

(6) If variable vane actuator was removed from right engine, install low pressure fuel filter. Refer to paragraph 5-49. If variable vane actuator was removed from left engine, install inlet fuel disconnect assembly. Refer to paragraph 13-77.

(7) Connect actuator on door 81L and close doors 22 and 82R.

9-26. **Rigging.** Refer to section IV.

SHOP MAINTENANCE

9-27. MAINTENANCE PROCEDURES.

9-28. This section provides maintenance procedures applicable to components/systems when removed from the aircraft. Table 9-3 lists the functional line replaceable units (LRU) of the system with the location of applicable maintenance procedures. Shop maintenance procedures, when contained in this manual are referenced by paragraph numbers; when contained in accessory publications; when contained in accessory publication, the T.O. numbers of the applicable manuals are listed. Manuals in the F-4 series or in general aircraft series are listed when containing procedures directly applicable to the LRU. When separate overhaul/illustrated parts breakdown manuals have been provided, the T.O. numbers are listed.

9-29. PACKAGING.

9-30. Components to be forwarded to the next higher level of maintenance for repairs, test, or check must be cleaned, perserved and packaged for protection against physical and mechanical damage during sebsequent handling, shipping and storage. For preservation and packaging methods referred to herein, refer to AFP 71-4 volumes 1 and 2. Components packed for forwarding must further be identified, marked and documented in accordance with applicable Air Force procedures.

Table 9-3. Line Replaceable Units

Line Replaceable Unit	Manufacturers Part Number	Applicable Maintenance Procedures/Publications Shop (Intermediate Level)	Applicable Maintenance Procedures/Publications Overhaul/IPB
Variable vane actuator	512D837P1	T.O.2J-J79-46	

SECTION X

ANTI–ICING AND AIR BLEED SYSTEMS

DESCRIPTION

10–1. **SYSTEMS.**

10–2. Aircraft requirements for engine supplied bleed air are fulfilled by the following system or units: boundary layer control system, cabin refrigeration unit, and equipment refrigeration unit. All of the above systems utilize engine compressor bleed air tapped off the 17th stage of the engine compressor. Normally, both engines supply the air for the operation of these systems but when necessary single engine operation supplies sufficient air for their operation.

10–3. A check valve and ducting is installed to each engine by the installation of the QEC kit. The functional control of the bleed air is initiated by the demand of each individual system and is regulated, (e.g. flow, temperature and pressure) by the system. The bleed air check valve prevents loss of bleed air through the opposite engine:

a. From the engine being operated.

b. From the engine being operated at a higher RPM.

10–4. **COMPRESSOR LEAKAGE AIR.** Air is discharged through three ports on the compressor radar frame. Ducts are installed on the ports as part of the QEC kit. These ducts keep the engine bleed air from impinging on the airframe structure and causing overheating of the structure.

10–5. For specific details of the bleed air systems refer toT.O.1F–4C–2–7.

10–6. See figure 10–1. The anti–icing system prevents the formation of ice on the struts of the compressor front frame, the inlet guide vanes, first stage stator vanes, and the engine nose dome.

10–7. **COMPONENTS.**

10–8. See figure 10–1. The anti–icing system includes the anti–icing valve and anti–icing indicator switch along with provisions for anti–icing the engine nose dome.

10–9. **ANTI–ICING VALVE.** The anti–icing valve controls and regulates the flow of anti–icing air. The anti–icing valve which is at the 12 o'clock position on the compressor rear casing, consists of a solenoid operated poppet valve, a relief valve assembly, and a valve assembly with enclosed actuating mechanism. The spring loaded solenoid poppet controls the ambient vent, the control orifice in the upstream sensing line, and flow in the reference pressure chamber. The relief valve assembly consists of a spring loaded bleed off poppet. The spring loaded actuating piston separates the reference pressure and the regulated pressure chambers. The actuating piston is connected to, and moves the main poppet valve. The balancing piston separates the regulated pressure chamber from the part of the body that contains inlet (compressor discharge) pressure. The valve is designed to operate under conditions shown in Table 10–1.

10–10. **ANTI–ICING INDICATOR SWITCH.** The anti–icing indicator switch is at the 11 o'clock position on the compressor front casing and completes a 28/14 Vac circuit to illuminate a cockpit light when anti–icing valve downstream static pressure exceeds the compressor inlet static pressure by more than 1.5 $\pm$0.5 psi. The pressure difference is 2.5 $\pm$0.2 psi on all engines numbered 418–535 and higher and all other engines using a P2 indicator switch.

Table 10–1. Anti–Icing System Leading Particulars

ANTI–ICING VALVE OPERATING CONDITIONS:	
Altitude	Sea level to 40,000 feet
Ambient pressure	30 psia (maximum)
Ambient temperature	Valve closed −54° to 246°C (−65° to 475°F) Valve open: −54° to 166°C (−65° to 300°F)
Humidity	10 to 100 percent from −54° to 54.4°C (−65° to +130°F)
Operating conditions	Air (valve open): −54° to 427°C (−65° to 800°F) at 0 to 200 psig Air (valve closed): −54° to 538°C (−65° to 1000°F) at 0 to 275 psig
Electrical input	102 to 124 volts at 380 to 420 cps, or 110 to 120 volts at 320 to 510 cps

OPERATION

10–11. **SEQUENCE OF OPERATION.**

10–12. **ANTI–ICING VALVE.** See figure 10–1. During non–anti–icing operation the solenoid is deenergized. Ambient air enters through the ambient vent at the solenoid and check valve assembly and passes through the reference pressure air tube into the reference pressure chamber. There, it is directed against the upper surface of the actuating piston.

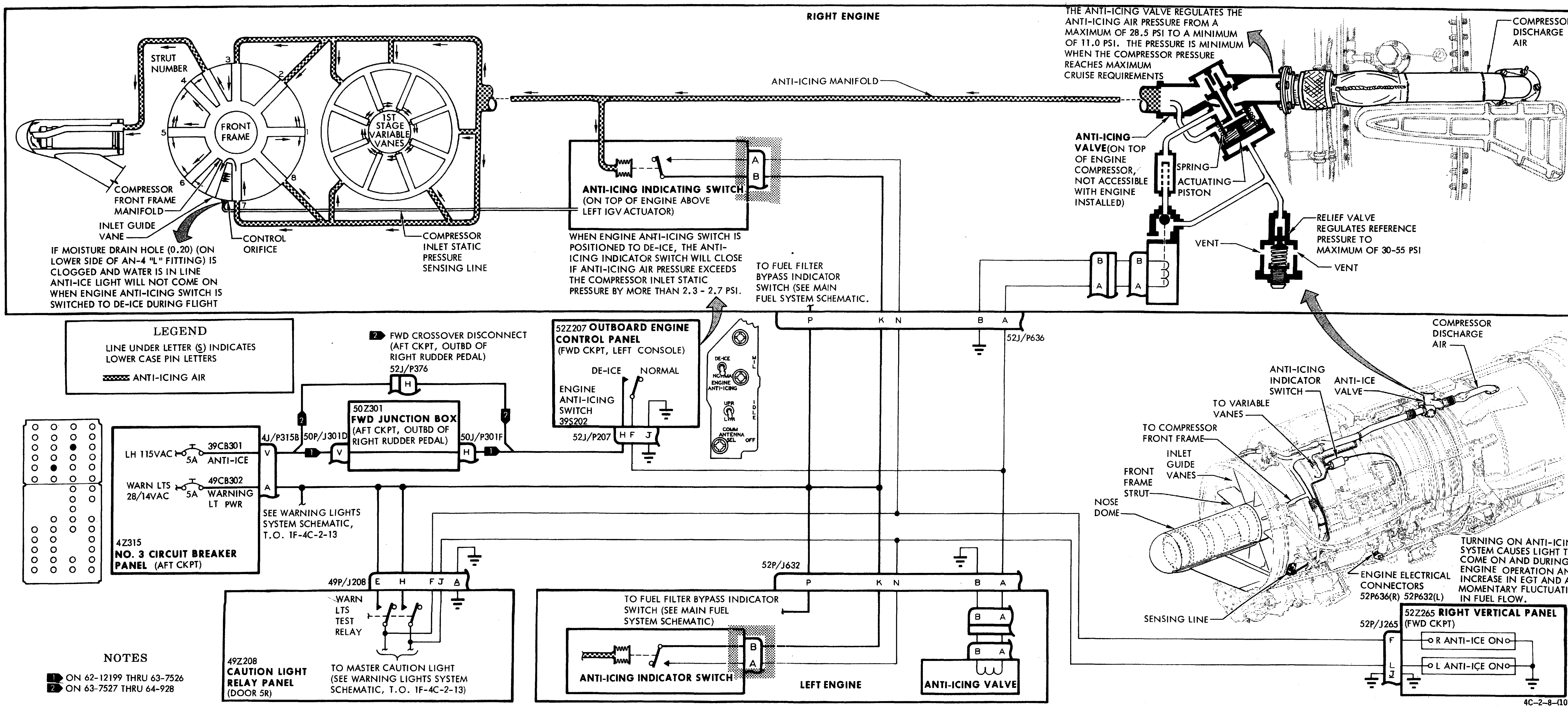


Figure 10-1. Anti-Icing System Schematic

10–13. Compressor discharge air enters the valve through the inlet port and is directed against the upper surface of the main poppet and against the bottom of the balancing piston. The combined force of the ambient air on the upper surface of the actuating piston and the compressor discharge air on the upper surface of the main poppet, is not sufficient to overcome the force of the spring on the bottom of the actuating piston and compressor discharge pressure on the bottom of the balancing piston; therefore, the valve remains closed.

10–14. When the solenoid is energized, the solenoid check valve is displaced to a position where it blocks the ambient vent and allows passage of compressor discharge air through the strainer, the control orifice, and the reference pressure air tube into the reference pressure chamber. This increased pressure on the upper surface of the actuating piston, coupled with the compressor discharge pressure on the upper surface of the main poppet, exceeds the force of the actuating piston spring and the compressor discharge pressure on the bottom of the balancing piston. The resultant movement of the actuating piston unseats the main poppet, and anti–icing air passes to the compressor front frame.

10–15. To maintain the downstream pressure of the anti–icing air at approximately 11 to 28.5 psi, air is directed from near the outlet port through the regulated pressure air tube, into the regulated pressure chamber. The force of the regulated pressure air and the spring against the bottom of the actuating piston repositions the main poppet as necessary to reduce the downstream pressure to within limits.

10–16. The relief valve assembly prevents the reference pressure from exceeding a predetermined maximum, which is established by setting the adjusting screw. When this maximum (normally 30 to 35 psi) is reached, the spring–loaded bleed off poppet of the relief valve assembly opens, and a portion of the reference pressure air passes overboard to ambient.

10–17. Discharge air from the anti–icing valve is regulated to a maximum of 28.5 psi and decreases to 11 psi as the compressor discharge pressure increases above the pressure required for maximum output. Regulation of the discharge air determines the flow in the system and thereby controls the temperature of the components being anti–iced. The bleed off poppet and spring regulate the air in the reference pressure chamber to a fixed pressure that controls the discharge pressure of the valve. When output pressure ported to the regulated pressure chamber exceeds a fixed value, the bleed off poppet moves and decreases reference pressure; then outlet pressure and spring tension close the main poppet enough to restore the predetermined discharge pressure.

10–18. **ANTI–ICING INDICATOR SWITCH.** The anti–icing indicator switch consists of a bellows which has anti–icing duct air pressure inside it and compressor inlet pressure taken from a port through a bolt in the mounting pad of the CIT sensor on the compressor front frame around it. Whenever the pressure in the bellows exceeds the pressure around the bellows by 1.5 $\pm$0.5 psi (the pressure difference is 2.5 $\pm$0.2 psi on all engines numbered 418–535 and higher and all other engines using a P2 indicator switch). The bellows holds the contacts closed.

10–19. **ANTI–ICING OF ENGINE NOSE DOME.** Compressor discharge air passes through a port in the upper combustion casing into the anti–icing air tube, which directs it to the anti–icing valve. When this valve is energized open by the cockpit switch, anti–icing air is conducted through the struts to the internal hub manifold into a line, through the engine gearbox and into the nose dome anti–icing line. Anti–icing air is directed to the hollow chamber in the forward end of the engine nose dome by the anti–icing line. This air bleeds down the inside leading edge of the nose dome strut and into a tube at the bottom of the strut. The tube directs the air to a passage in the strut cover through which the air flows to the top of the strut. The air then flows into the strut cavity and is dispersed into the inlet air stream through holes in the strut cover. This practically eliminates the possibility of ice ingestion of the engine by the nose dome.

THEORY OF OPERATION

10–20. GENERAL.

10–21. See figure 10–1. Compressor discharge air passes through a port in the upper combustion casing into the anti–icing air tube, which directs it to the anti–icing valve. This valve normally remains closed to prevent the passage of anti–icing air to the compressor front frame and the compressor front casing manifold. When the anti–icing switch is closed in the cockpit, a solenoid in the valve is energized and the valve opens. When the valve is open and air is flowing sufficiently in the line, the anti–icing indicator switch completes a circuit and illuminates a cockpit light to give a visual indication of airflow.

10–22. When the valve opens, anti–icing air flows to the compressor front frame and the compressor front casing. The pressure of the air is regulated within the anti–icing valve.

10–23. At the compressor front casing, the anti–icing air flows through the five tubes into a manifold over the first stage stator vanes. From the manifold, the air passes through the stator vanes and returns to the primary air stream through two slots at the inner end of each vane.

AIRCRAFT MAINTENANCE

10–24 REMOVAL, INSTALLATION AND ADJUSTMENT.

10–25. Refer to T.O.2J–J79–46 for anti–icing valve removal and installation procedures.

10–26. Refer to T.O.1F–4C–10 for air bleed duct removal and installation procedures.

10–27. **INSPECTION AND REPAIR.** Refer to T.O.1F–4C–3 series for inspection criteria and repair procedures for damaged bleed air ducts.

SHOP MAINTENANCE

10-28. MAINTENANCE PROCEDURES.

10-29. This section provides maintenance procedures applicable to components/systems when removed from the aircraft. Table 10-2 lists the functional line replaceable units (LRU) of the system with the location of applicable maintenance procedures. Shop maintenance procedures, when contained in this manual, are referenced by paragraph numbers; when contained in accessory publication, the T.O. numbers of the applicable manuals are listed. Manuals in the F-4 series or in general aircraft series are listed when containing procedures directly applicable to the LRU. When separate overhaul/illustrated parts breakdown manuals have been provided, the T.O. numbers are listed.

10-30. PACKAGING.

10-31. Components to be forwarded to the next higher level of maintenance for repairs, test or check must be cleaned, preserved and packaged for protection against physical and mechanical damage during subsequent handling, shipping and storage. For preservation and packaging methods referred to herein, refer to AFP 71-4 volumes 1 and 2. Components packed for forwarding must further be identified, marked and documented in accordance with applicable Air Force procedures.

Table 10-2. Line Replaceable Units

Line Replaceable Unit	Manufacturers Part Number	Applicable Maintenance Procedures/Publications Shop (Intermediate Level)	Applicable Maintenance Procedures/Publications Overhaul/IPB
Nose dome anti-icing line	53-50024-301	None required	None required

SECTION XI

CONSTANT SPEED DRIVE SYSTEM

DESCRIPTION

11-1. SYSTEM DESCRIPTION.

11-2. The inlet gearbox on the compressor front frame provides a mounting pad for constant speed drive (CSD) and ac generator units. The entire assembly is enclosed by the engine nose dome assembly. An anti-icing line protruding from the inlet gear box provides anti-icing air to the nose dome when the anti-icing air valve is energized. This practically eliminates the possibility of ice ingestion of the engine from the nose dome. Two hollow, streamlined struts, which are an integral part of the engine nose dome assembly, provide the necessary service line routing. The left strut provides routing for the CSD overboard drain line and the generator electrical bundle. The right strut provides routing for the oil supply and oil return lines. The CSD unit and the ac generator use engine oil for normal operation, lubrication and cooling. The CSD oil system consists of the engine oil tank, a scavenge oil filter, an oil servicing bracket, quick disconnect fittings for convenience of removal and installation, and the necessary lines. See figure 11-1.

11-3. COMPONENT DESCRIPTION.

11-4. **CSD FILTERS.** The filter is in the CSD oil return line and mounted on the oil servicing bracket at the bottom of the engine compressor casing. It includes a pressure relief bypass valve that opens at 35 $\pm$4 psi. The filter element is accessible through access doors 81L/R and 82L/R on the bottom of the aircraft.

11-5. **QUICK DISCONNECT.** See figure 11-2. An aeroquip quick disconnect coupling is installed on the engine between the oil tank supply line and the CSD oil inlet line. This coupling is equipped with three indicator pins which protrude through the knurled locking roller on the female half of the coupling. The three indicator pins can be seen and felt when the quick disconnect coupling is in the locked position. The quick disconnect coupling is connected mechanically through positive right hand thread action.

11-6. **ENGINE OIL TANK.** Refer to section VIII.

11-7. **OIL SERVICING BRACKET.** Refer to section VIII.

OPERATION

11-8. SEQUENCE OF OPERATION. See figure 11-1.

11-9. Oil for lubrication, operation and cooling of the CSD and ac generator is provided by the engine oil system. A pressure head in the engine oil tank causes oil to flow to the CSD. The CSD oil pump circulates the oil through the CSD and ac generator unit for operation, lubrication and cooling and returns it to the engine oil tank. A filter in the return line screens out foreign material before the oil enters the engine oil tank. For additional system and component theory of operation refer to T.O.1F-4C-2-13.

TOOLS AND TEST EQUIPMENT.

11-10. GENERAL.

11-11. To perform maintenance on the system or components, the special tools and test equipment listed in table 11-1 and illustrated in figure 11-3 should be used. Alternate equipment with equal or greater range and accuracy than that in the Alternate Equipment column may be substituted. The listed tools and test equipment are for performing aircraft and shop maintenance procedures covered in this section of the manual.

11-12. The tools shown in figure 11-3 (except those listed in table 11-1) are not classified as special tools. The tools shown are suggested standard tools to be used in the removal and installation of the engine nose dome assembly and CSD/ac generator unit. If the suggested standard tools are used, the illustration may also be helpful as an index, when accounting for tools after removal and installation procedures have been completed.

Table 11-1. Tools and Test Equipment

Name	Identification No.	Alternate Equip. Range	Alternate Equip. Accuracy	Use
Oil servicing unit	PMU-29/E			Engine oil tank servicing and CSD priming.
CSD and generator skid assy.	53E390194-1			To transport the CSD and generator through forward fuselage air duct.
CSD and generator hoist assy.	53E390003-1			To raise and hold CSD and generator in position for mounting to engine locking ring.

CONTINUED

Table 11-1. Tools and Test Equipment

Name	Identification No.	Alternate Equip. Range	Alternate Equip. Accuracy	Use
Dome cover assembly	53E390004-1			To protect duct surface during installation or removal of dome assembly.
Wrench, torque		0 to 600 inch-pounds	Torque CSD/gen erator fittings.	

AIRCRAFT MAINTENANCE

11-13. REMOVAL AND INSTALLATION.

11-14. CONSTANT SPEED DRIVE AND GENERATOR REMOVAL AND INSTALLATION. See figure 11-4.

CAUTION

Prime CSD system after replacing CSD unit, to prevent damage to new CSD unit.

11-15. For additional replacement and adjustment information refer to T O 1F-4C-2-13.

11-16. CLEANING, DRAINING AND LUBRICATION.

11-17. For additional information concerning cleaning, draining and lubrication, refer to T O 1F-4C-2-13.

11-18. CLEANING.

11-19. **Constant Speed Drive Oil Filter.** See figure 11-5.

11-20. Deleted.

11-21. NOSE DOME AND CSD/GENERATOR REMOVAL AND INSTALLATION. See figure 11-4.

11-22. **Tools and Equipment.**

Cover assembly 53E390004
Safety clip, MDE321041
Skid assembly, 53E390002
Hoist assembly, 53E390003

11-23. **Materials.**

Lockwire, MS20995NC32
Tape, P-211
Solvent, P-D-680, Type II
Lubricant, Plastilube Moly Grade 3
Grease, MIL—L—25681
Oil, MIL—L—7808
Lockwire, MS20995NC20

11-24. **Manpower Requirement.**

a. Two men required.

11-25. **Removal.**

WARNING

With variable ramp in retracted position, pull both variable ramp control circuit breakers and install safety clip so not to cause personnel injury.

To prevent injury to personnel, make sure safety struts are installed on door 81L and R actuators.

CAUTION

Exercise care when entering or leaving the intake duct to prevent damage to the bellmouth pitot probe. A cardboard box or equivalent soft construction container should be employed as a receptacle for small parts to prevent damage to duct skin and as an aid in preventing FOD to the engine. The gap between the engine and the bellmouth and all intake duct openings in the vari-ramp area should be taped over to prevent foreign objects from lodging in these locations.

a. Disconnect CSD supply line disconnect through door 81L or 82R.

b. Enter inlet duct and install bellmouth pitot cover.

c. Remove dome strut covers.

d. Open nose dome doors.

e. Remove anti-ice line.

f. Disconnect CSD oil supply and return lines.

NOTE

Place rags in strut areas to absorb any oil lost during removal of oil lines.

g. Turn out oil supply and return line fittings and install dirt plugs.

h. Remove CSD drain line and turn out drain line fitting. Install dirt plug.

i. Disconnect electrical plug and remove clamps.

CAUTION

Exercise extreme caution when removing or installing generator electrical leads, to prevent excessive bending or scraping of wire bundle and to prevent breaking terminal board insulation or dividers.

j. Remove bolts that attach struts to oil cooler pads. Twist nose dome assembly counterclockwise (looking aft)

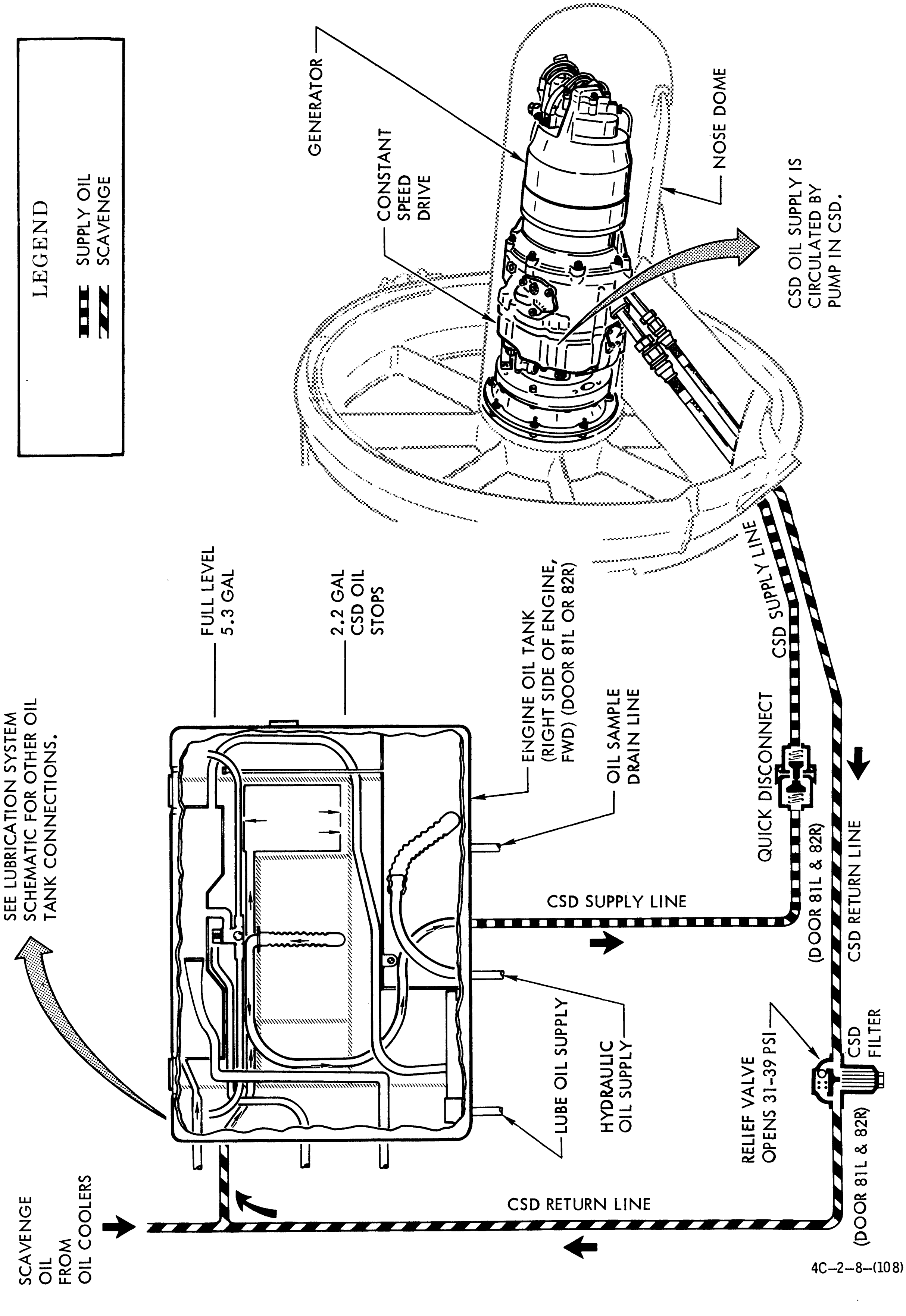


Figure 11-1. Constant Speed Drive Oil System Schematic

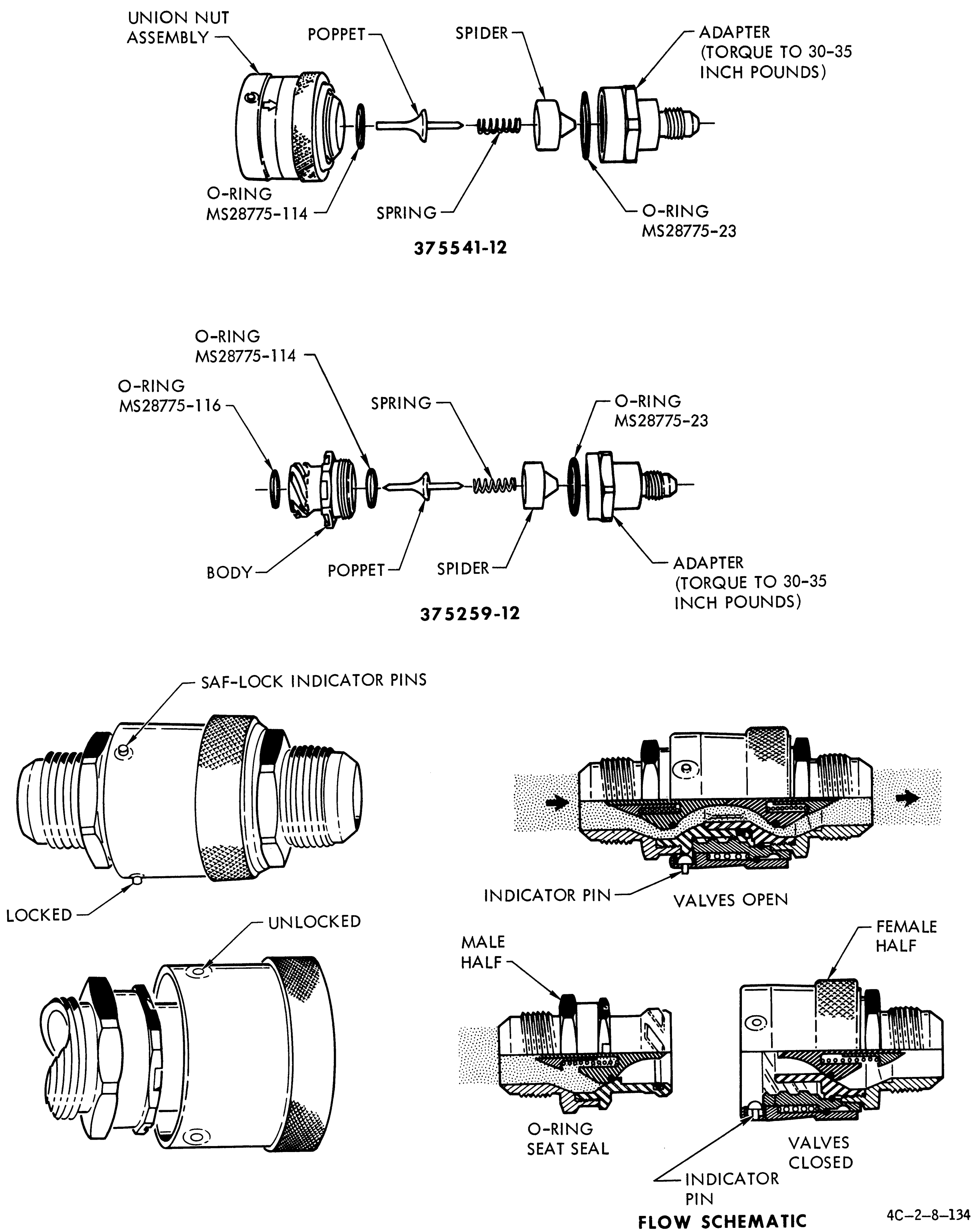


Figure 11-2. Constant Speed Drive Quick Disconnect Coupling

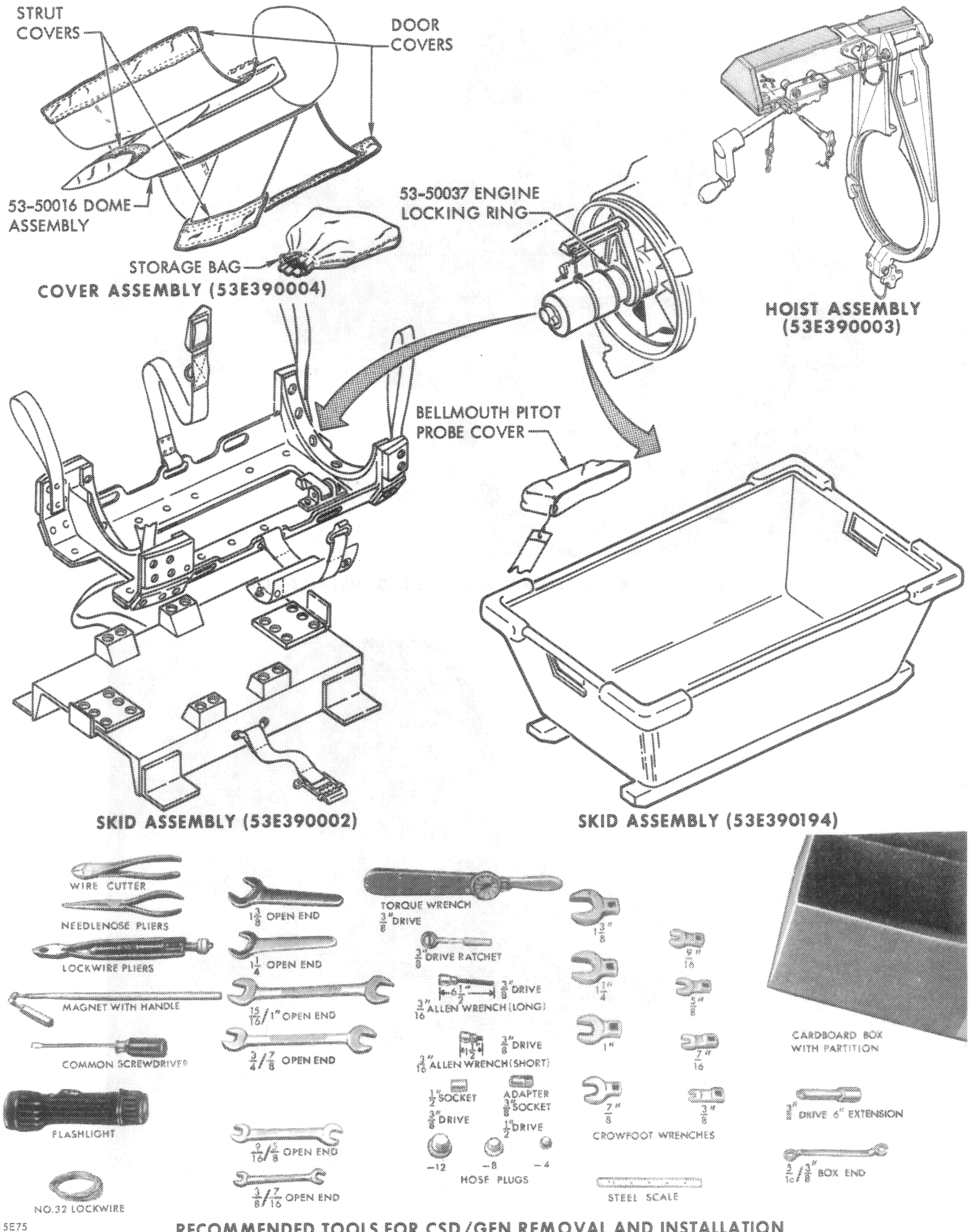


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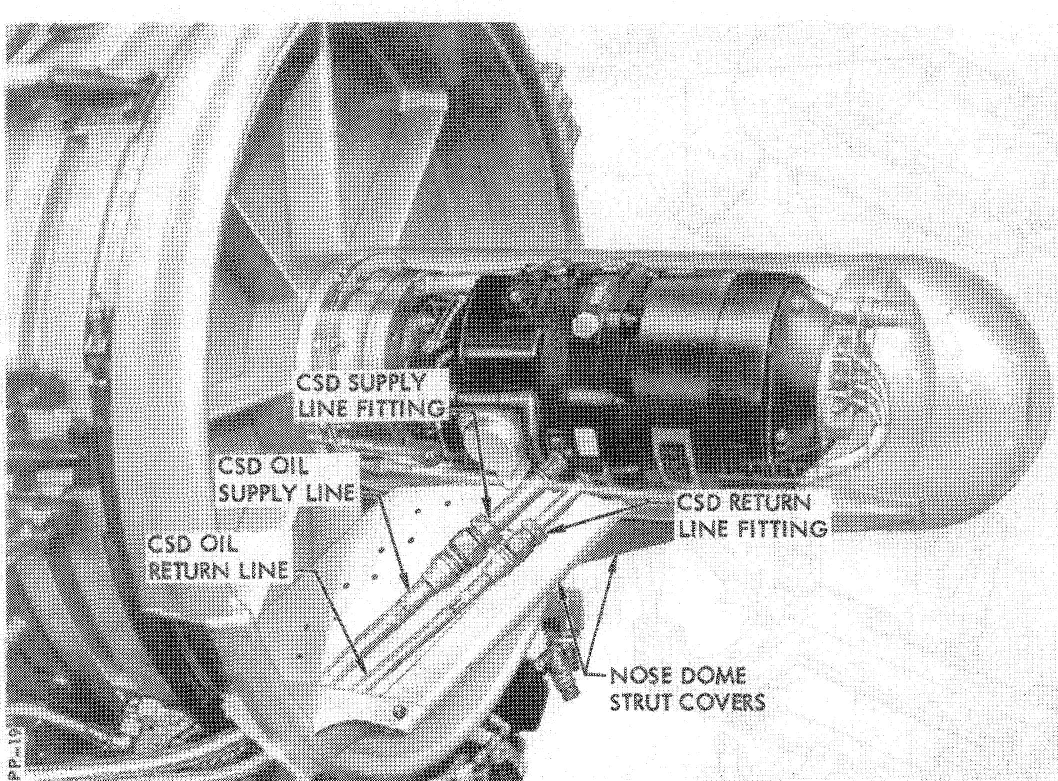
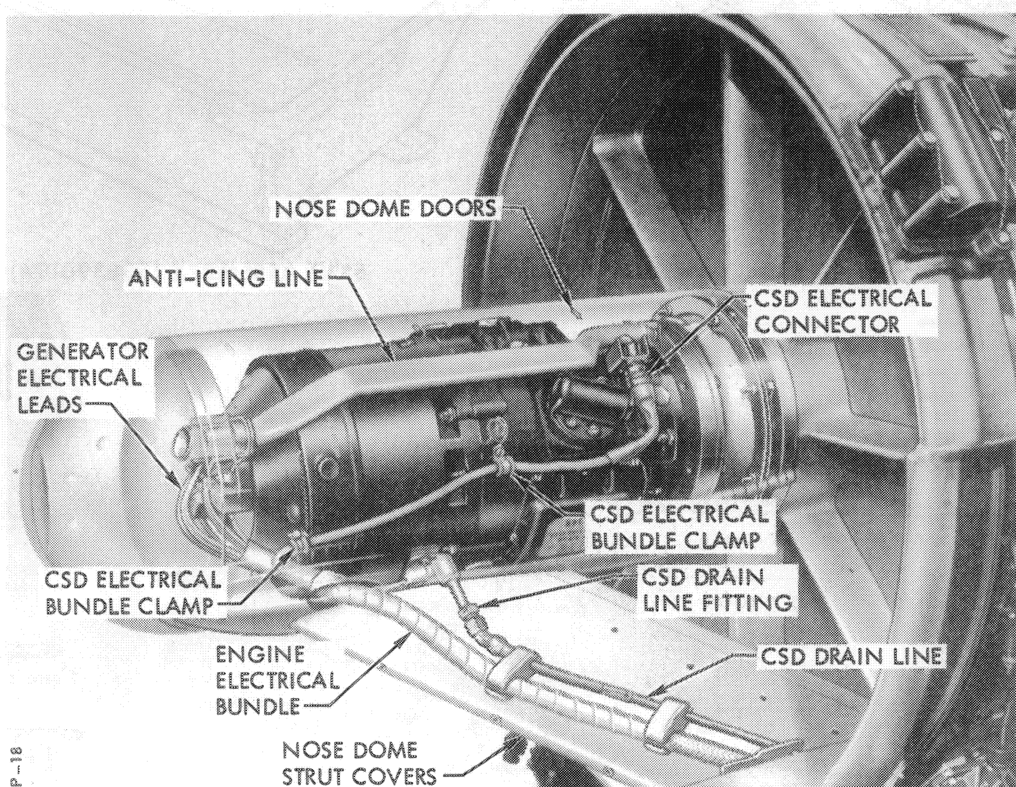
Figure 11-3. Constant Speed Drive and Generator Tools and Equipment



RIGHT VIEW OF GENERAL ELECTRIC CSD INSTALLATION



LEFT VIEW OF GENERAL ELECTRIC CSD INSTALLATION

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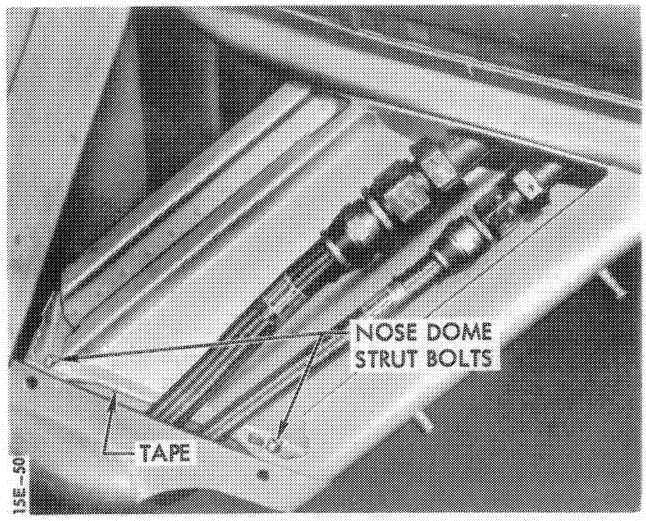
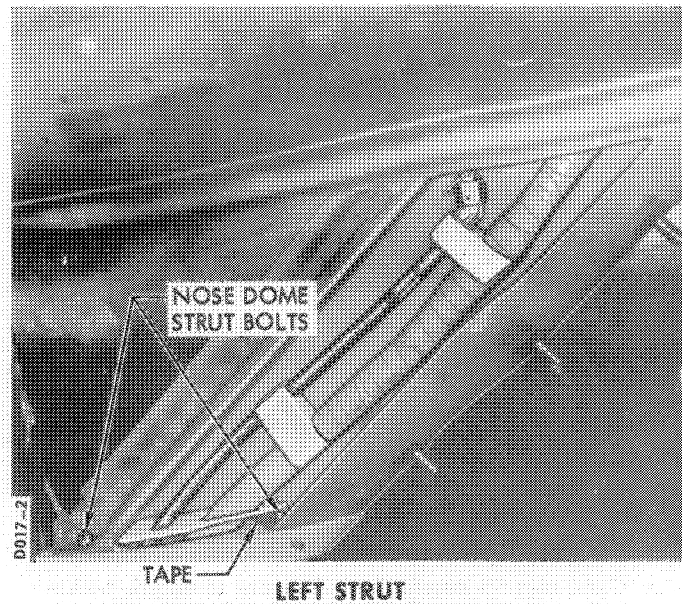
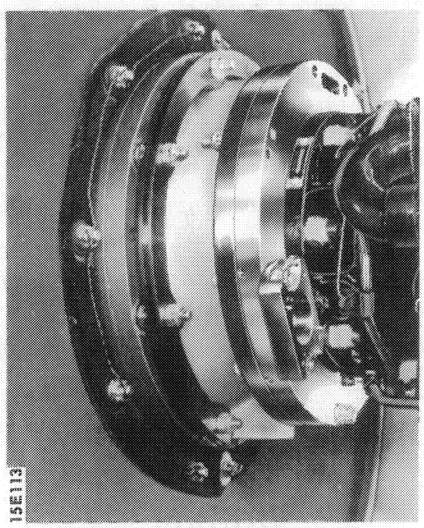
Figure 11-4. Constant Speed Drive and Generator Removal and Installation (Sheet 1 of 2)



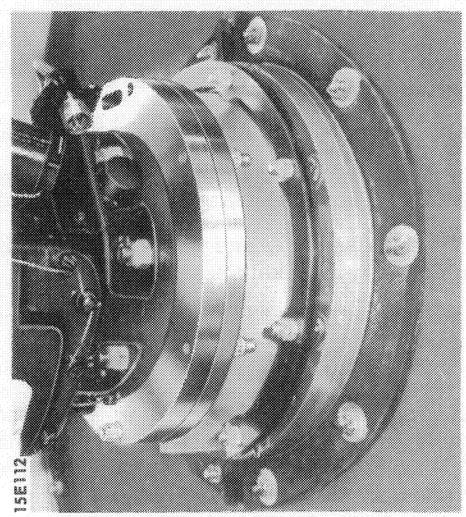
RIGHT STRUT



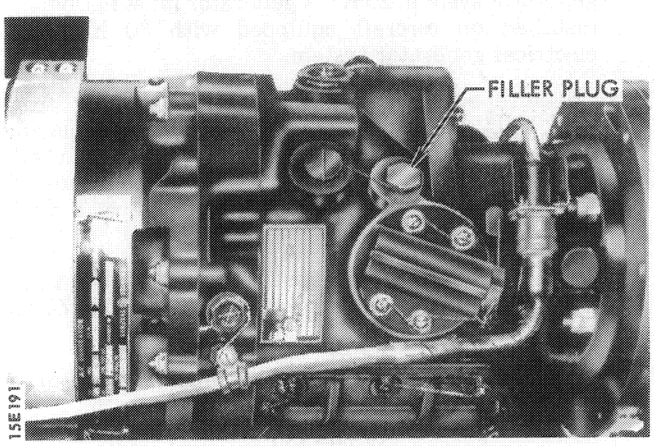
LEFT STRUT



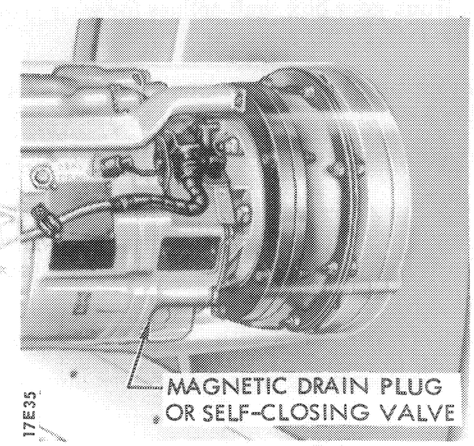
RIGHT SIDE OF NON-RIGID CSD MOUNT



LEFT SIDE OF NON-RIGID CSD MOUNT



GENERAL ELECTRIC CONSTANT SPEED DRIVE



SUNDSTRAND CONSTANT SPEED DRIVE 4C-2-8-(130-2)

Figure 11-4. Constant Speed Drive and Generator Removal and Installation (Sheet 2 of 2)

to free and pull forward until generator leads are accessible. Disconnect leads.

k. Pull electrical bundle through opening in dome. When dome is free, install covers and pull dome from aircraft through air duct. Position strut legs inboard and dome doors open, remove dome from inlet duct.

l. Check engine oil for contamination due to possible CSD failure. Refer to section VIII. If oil is found to be contaminated, drain and service oil tank. Refer to T.O.1F-4C-6 section II.

m. Install hoist assembly into air duct, remove pip pin from rail assembly. Raise rail assembly from its stowed position. Reinstall pin.

n. Loosen knob on swing bolt, remove swing bolt from slot. Open clamp assembly.

o. Move clamp assembly around engine dome locking ring with rail assembly up. *Assure lug provided on clamp assembly engages to stud or gearbox pad.*

p. Close clamp assembly and secure to engine locking ring by moving swing bolt into slot and tighten knob as required.

q. Remove three CSD unit attach bolts, 6 o'clock and two at 4 o'clock. Attach saddle assembly to constant speed drive and generator.

r. Insert snap hook into D ring of saddle assembly.

s. Rotate hand crank to tension cable and then remove nuts from mounting studs on rear of coupling assembly.

t. Pull skate assembly and CSD forward to disengage CSD from engine. Pin skate assembly to hoist.

u. Rotate hand crank to lower units to floor of the air duct. Remove hoist hook from hoisting ring.

CAUTION

When removing CSD/generator and saddle assembly from intake duct, mechanic should precede assembly to prevent it from being inadvertently dropped from intake duct.

v. Pull CSD/generator and saddle assembly from intake duct.

w. Check front gear box shaft splines for wear in accordance with T.O.2J-J79-46.

x. Cover gear box pad with a suitable item to keep out dirt and other foreign material.

11-26. Servicing Sundstrand Constant Speed Drive.

CAUTION

Servicing of Sundstrand Constant Speed Drive must be accomplished before mating generator to drive.

a. Turn drive vertically with input drive on top.

b. Remove self closing valve assembly and magnetic drain plug.

c. *Fill drive unit with engine lubricating oil, approximately one quart is required.*

d. Install self closing valve assembly. *Torque 55 to 75 inch-pounds and lockwire.*

e. Install magnetic drain plug. *Torque 30 to 40 inch-pounds and lockwire.*

NOTE

Replace all damaged O rings.

f. Install O ring on hydraulic connectors.

g. Lubricate generator input shaft spline with Plastilube Moly Grade 3.

h. Install generator on drive and install nuts. *Torque 50 to 70 inch-pounds.*

11-27. Servicing General Electric Constant Speed Drive.

a. Stand drive vertically on input end shipping cover.

b. Remove output end shipping cover, and hydraulic connector shipping caps.

c. Lubricate O rings with clean engine oil and install O ring on hydraulic connectors.

d. Remove shipping plug from generator drive spline. Inspect packing located inside output clutch assembly for damage. Replace if necessary.

NOTE

It is normal for a small amount of oil to run out of output clutch assembly area when shipping plug is removed.

e. *Lubricate generator input drive splines with Plastilube Moly Grade 3.*

f. Install generator and nuts on drive. *Torque 50 to 70 inch-pounds.*

g. *Remove magnetic drain plug and fill drive with engine lubricating oil.*

h. Install magnetic drain plug. *Torque 30 to 40 inch-pounds and lockwire.*

11-28. Installation.

CAUTION

To prevent possible failure of generator or aircraft wiring, do not install 30 KVA generator on aircraft equipped with 20 KVA electrical generator system. 20 KVA generator must not be installed on aircraft equipped with 30 KVA electrical generator system.

a. Remove soft coupling and drain assembly from removed CSD/generator unit and install on replacing unit. Apply one layer of permacel tape between soft coupling and generator. *Torque bolts on generator to coupling 190 to 230 inch-pounds. Secure screws in drain line with lockwire.*

b. Clean CSD and generator splines with solvent and small brush. *Lubricate splines with Plastilube Moly Grade 3.*

c. Attach the saddle assembly to constant speed drive and connector.

WARNING

Bellmouth pitot probe can cause injury to personnel or be damaged. Use care when entering or leaving duct.

CAUTION

Exercise caution when entering and leaving intake duct not to damage to aircraft duct surface.

d. Insert units into duct with generator coupling entered first, move units up duct to where hoist assembly is installed.

e. Remove cover from gearbox cover.

f. Connect saddle assembly D ring to snap hook.

g. Lubricate soft coupling bolts and face of washers with MIL–L–25681.

CAUTION

When installing CSD, assure CSD splines fully engage engine splines by rotating compressor a minimum of 3 blades clockwise and counterclockwise immediately after installation.

h. Rotate hand crank and raise CSD and saddle assembly, unpin skate assembly and move skate and CSD assembly toward gearbox. Align splines and coupling bolts.

i. Install bolt at 6 o'clock position with head facing forward — torque bolt 250—270 inch—pounds and secure with MS20995NC32 lockwire. Install nuts at 2, 8 and 10 o'clock positions. Torque nuts 250—270 inch—pounds.

j. Install remaining two bolts at 4 o'clock position. *Torque 70 to 80 inch—pounds and lockwire.*

k. Unhook D ring from hoist and remove saddle assembly from CSD/Generator unit. Remove hoist assembly.

l. Install single layer of permacel tape to oil cooler strut pads.

m. Install dome assembly in air duct, position struts down and facing gearbox pad. Move dome through air duct and position it forward of CSD/Generator unit and feed electrical bundle through opening in dome.

CAUTION

Exercise extreme caution when installing generator electrical leads, to prevent breaking terminal board insulator dividers.

Caution should be taken to hold the electrical terminals in place while the nut is tightened to prevent rotation of the terminals. This will help prevent broken generator leads and premature failures.

n. Connect generator leads as follows: Connect lead V75 to terminal G, X55 to terminal T1, X56 to terminal T2, X57 to terminal T3, X74 to terminal F, X65 to terminal P. Install washers and nuts. *Torque 60 to 85 inch—pounds.*

o. Rotate dome to position it on oil cooler strut pads. Install dome strut to pad attach bolts.

p. Install CSD electrical connector and lockwire. Install electrical bundle bracket, spacer, and clamps.

q. Remove dirt plugs and install O—ring on CSD supply and return fittings. *Install supply fitting and torque 150 to 200 inch—pounds.* Install return fitting. *Torque 110 to 150 inch—pounds.*

NOTE

Use wrench to hold CSD fittings when torquing supply and return line nuts.

r. Connect CSD supply line to fitting. *Torque 300 to 500 inch-pounds.* Connect CSD return line. *Torque 150 to 250 inch-pounds, lockwire each line to fitting.*

s. Install CSD drain line fitting and O ring into CSD drain assembly. *Torque 50 to 100 inch-pounds and lockwire.*

t. Connect CSD drain line to CSD drain line fitting. *Torque 50 to 100 inch—pounds and lockwire.* Perform CSD oil system priming procedure. Refer to paragraph 11–38.

u. Install dome assembly strut pad mounting bolts. Torque 50 to 70 inch—pounds and lockwire.

v. Install anti—icing seal on forward end of anti—icing line. Install seal and line into mount on nose dome assembly. Connect aft end of line with seal and bolts. *Torque 250 to 270 inch—pounds and lockwire.*

w. Install spacers between hose and wire bundle in left strut. Install teflon bushing around wire bundle, and insert bushing in dome opening with split in bushing pointing aft.

x. Install nose dome strut covers and strut door lock bolts. *Torque 50 to 70 inch—pounds.*

y. Close nose dome doors. *Torque bolts 50 to 70 inch—pounds.*

z. Remove bellmouth pitot cover, tools, equipment and all foreign matter, including tape, from air intake.

aa. Remove safety clip from Variable Ramp Control circuit breaker and reinstate breaker.

Connect CSD Supply Line disconnect through door 81L or 82R.

11–29. **CONSTANT SPEED DRIVE FILTER.** See figure 11–5.

11–30. **Tools and Equipment.**

Ultrasonic cleaning unit

11–31. **Materials.**

Lockwire, MS20995NC32
Solvent, P-D-680, Type II

11–32. **Disassembly.**

a. Remove clamp from around filter bowl.

b. Remove lockwire and filter bowl filter head.

c. Remove filter element.

11–33. **Cleaning.**

NOTE

Filter element may be cleaned only if replacements are not available.

a. Before cleaning element, cover end with a suitable fixture to prevent contamination from entering interior of filter.

b. Clean filter element and bowl using cleaning solvent P–D–680 or other suitable cleaner and a brush that has soft bristles, longer than depth of pleats in filter element.

c. A preferred alternate method of cleaning is ultrasonic cleaning if equipment is available. Clean filter

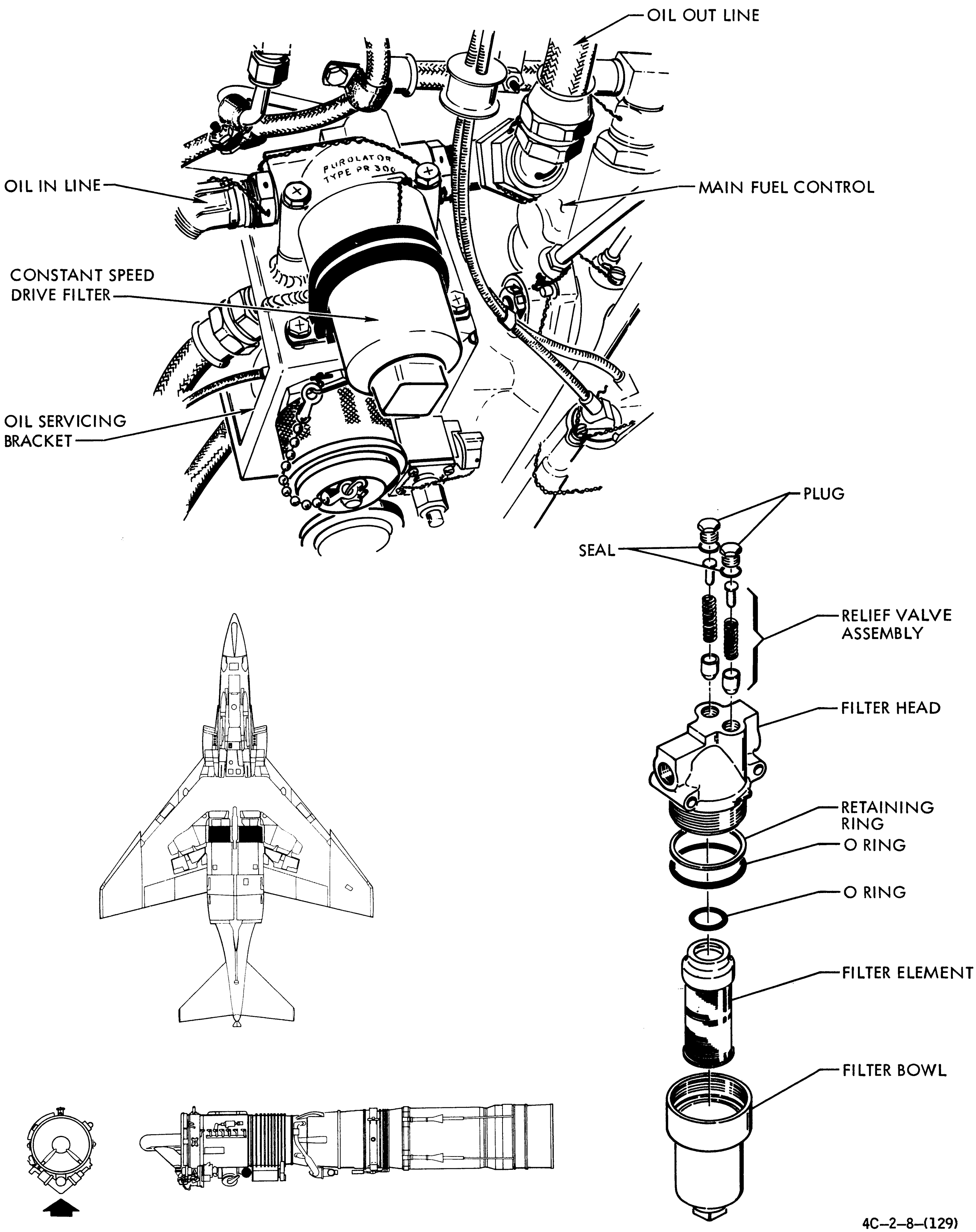


Figure 11-5. Constant Speed Drive Filter

for 5 minutes at room temperature using trichlorethylene or equivalent. Position element horizontally in cleaning tank and rotate 90 degrees after each minute of cleaning. Backflush if possible.

CAUTION

Air pressure must not exceed 40 psig maximum to prevent filter element damage.

d. Shake or blow excess solvent from filter element.

11-34. **Inspection.**

a. *Inspect filter element for tears, buckling, and obstructions.*

b. *Inspect seal seating surface for burrs.*

11-35. **Repair and Parts Replacement.**

a. Replace filter element if replacements are available.

b. Replace retaining ring and O rings.

11-36. **Assembly.**

a. Insert filter element into bowl.

b. Screw bowl onto filter head.

c. *Torque bowl 100 to 200 inch-pounds.*

d. *Secure bowl with lockwire.*

e. Install clamp around filter bowl.

11-37. **Testing.**

a. Check assembled filter for leaks during engine operation.

11-38. **CONSTANT SPEED DRIVE OIL SYSTEM PRIMING PROCEDURES.**

11-39. **Tools and Equipment.**

Oil Servicing Unit
Torque wrench, 0 to 100 inch-pounds
Torque wrench, 0 to 600 inch-pounds

11-40. **Materials.**

Oil, MIL-L-7808

11-41. **Manpower Requirement.**

a. Two men required.

11-42. **Procedure.**

NOTE

Prior to engine operation and after assuring all lines and components have been properly installed, engine oil tank must be serviced and CSD oil system primed per following steps.

11-43. **Static Priming.**

a. CSD unit should be serviced before installed on engine. Refer to paragraph 11-26 or paragraph 11-27 whichever is applicable.

NOTE

Sundstrand CSD cannot be serviced after it is installed on engine.

b. Service engine oil tank, refer to section VIII. Do not disconnect oil servicing unit from engine upon completion. Proceed with following steps to use oil servicing unit as a CSD system priming unit.

c. Disconnect oil servicing unit return line from engine oil servicing bracket to prevent any additional oil overflow.

NOTE

Do not disconnect oil servicing unit supply line.

d. Disengage quick disconnect located in CSD supply line between oil tank and CSD. Secure a spare female quick disconnect half with a short line attached and engage with male quick disconnect half on line to tank. With line open, operate oil servicing unit pump handle until steady flow of oil is observed. Stop pumping, and remove spare female quick disconnect half previously installed.

NOTE

Oil servicing unit is used to apply head pressure to oil tank, if required to start oil flowing.

e. Reconnect CSD supply line quick disconnect.

CAUTION

Faulty engagement of quick disconnect coupling will result in starvation, of oil and damage to CSD. Look for disconnect, pin-lock extension that assures full engagement. Refer to figure 11-2.

f. Loosen nut on CSD oil supply line fitting at CSD. Slowly operate pump handle. Jiggle line so air trapped in line can escape past threads of fitting. When oil droplets appear, assume CSD supply line is filled with oil. Tighten nut at once and wipe up any spilled oil in strut.

NOTE

Use a suitable cloth under and around fitting prior to applying oil will aid in eliminating nearly all spillage.

g. *Torque nut on oil supply line 300 to 500 inch-pounds.*

h. Reconnect oil servicing unit return line to engine oil servicing bracket and allow excess oil to drain from oil tank if overservicing of tank occured to fill CSD supply line.

i. Disconnect oil servicing unit supply and return lines from oil servicing bracket.

j. Install fairing covers on streamlined struts. *Torque bolts 50 to 70 inch-pounds.*

k. Close dome assembly doors. *Torque bolts 50 to 70 inch-pounds.*

11-44. **Motor Priming.**

a. Disconnect CSD return line from inlet side of CSD filter.

b. Motor engine at low rpm until oil flows freely from oil return line. Observe windmilling limits, refer to section II.

NOTE

This operation assures oil circulation from tank through CSD to filter and return to tank.

c. Connect oil return line to filter. *Torque 150 to 250*

inch–pounds.

d. Again service engine oil tank. Disconnect oil servicing unit and install caps on oil servicing adapters.

11-45. **CSD Oil System Priming Sequence Check List.**

a. Engine oil tank serviced and overflow line, full.

b. CSD supply line to quick disconnect, full.

c. CSD supply line to CSD, full.

d. CSD unit, full.

e. CSD return line to CSD filter, full.

f. Engine and CSD unit motored to check for flow at CSD return line.

CAUTION

To prevent damage to engine, install check valve on servicing unit supply hose to prevent oil tank draining into servicing unit.

g. Engine oil tank reserviced and oveflow indicated in return line to oil servicing unit.

h. *All connections loosened during priming, secured and lockwired.*

11-46. Removal, repair and installation of constant speed drive check valve (Sunstrand P/N 695216A).

11-47. **Tools and Equipment.**

Oil servicing unit
Torque wrench 0—600 inch—pounds
Safety clip MDE321041

11-48. **Materials.**

Oil, MIL—L—7808
O—Ring MS9388—011

11-49 **Manpower Requirement.**

Two men required

11-50. **Remove/Repair/Replace.**

WARNING

With variable ramp in retracted position, pull both variable ramp control circuit breakers and install safety clip.

CAUTION

Exercise care not to damage Bellmouth pitot probe when entering or leaving duct.

NOTE

A cardboard box or equivalent soft—construction—type box should be employed for catching small parts so that damage to the inlet duct skin is prevented.

a. Disconnect CSD supply line disconnect through door 81L & 82R.

b. Enter inlet duct and install bellmouth pitot cover.

c. Open nose dome doors.

d. Remove, repair/replace check valve as per T.O.9H6—3—25—2 paragraph 5-11u, item (1) through (7). Torque mounting screws 18—20 inch—pounds.

e. Wipe oil from CSD and dome.

f. Close dome doors; torque bolts 50—70 inch—pounds.

11-51. **Quality Assurance.**

a. *Assure all rags and other foreign material has been picked up and removed from air inlet ducts.*

b. *Account for all tools used.*

c. *Assure that nose dome doors have been properly secured.*

d. *Assure that CSD supply line is connected.*

11-52. **Leak Check.**

a. Perform engine run at idle RPM for 15 minutes.

b. Open nose dome doors and check for oil leakage. Static leak check for an additional 15 minutes.

NOTE

Wetting of valve is normal as long as drops do not form. If leakage is present, recheck O—Ring MS9388—018 for damage. If leakage is from check valve, repair/replace valve.

11-53. Close nose dome doors; torque bolts 50—70 inch—pounds.

11-54. Remove bellmouth pitot cover, tools, equipment and all foreign matter from air intake area, paragraphs 11-51a through c.

11-55. Remove safety clip from variable ramp control circuit breakers and reinstate breakers.

SHOP MAINTENANCE

11-56. MAINTENANCE PROCEDURES.

11-57. This section provides maintenance procedures applicable to components/systems when removed from the aircraft. Table 11-2 lists the functional line replaceable units (LRU) of the system with the location of applicable maintenance procedures. Shop maintenance procedures, when contained in this manual are referenced by paragraph numbers; when contained in accessory publication, the T.O. numbers of the applicable manuals are listed. Manuals in the F-4 series or in general aircraft series are listed when containing procedures directly applicable to the LRU. When separate overhaul/illustrated parts breakdown manuals have been provided, the T.O. numbers are listed.

11-58. PACKAGING.

11-59. Components to be forwarded to the next higher level of maintenance for repairs, test, or check must be cleaned, preserved, and packaged for protection against physical and mechanical damage during subsequent handling, shipping, and storage. For preservation and packaging methods referred to herein, refer to AFP 71-4 volumes 1 and 2. Components packed for forwarding must further be identified, marked and documented in accordance with applicable Air Force procedures.

Table 11-2. Line Replaceable Units

Line Replaceable Unit	Manufacturers Part Number	Applicable Maintenance Procedures/Publications Shop (Intermediate Level)	Applicable Maintenance Procedures/Publications Overhaul/IPB
AC generator	2CM26		T.O.8A6-6-7-3
Nose dome assembly	53-50016	T.O.1F-4C-10	T.O.1F-4C-3-1-4
CSD oil filter	59223		
Constant speed drive	695145C		T.O.9H6-3-25-2
Constant speed drive	7TAL10L03		T.O.9H6-4-3-2

SECTION XII

BASIC POWER PLANT

DESCRIPTION

12-1. **SYSTEM.** See figure 12-1.

12-2. The J79 engines are axial-flow turbojet engines with variable afterburner thrust. They incorporate a 17-stage compressor of which the angles of the inlet guide vanes and the first 6 stages of stator vanes are variable; a combustion system which consists of 10 individual combustion liners situated between an inner and outer combustion casing; a 3-stage turbine rotor, which is coupled directly to the compressor rotor; and an afterburner system, which provides afterburner thrust variation through fuel flow scheduling and actuation of the variable area, converging diverging type exhaust nozzle. The rotors are supported by three main bearings.

12-3. **COMPONENTS.**

12-4. The main sections, drive systems, bearing, and seal areas are as follows:

a. Compressor section.

b. Combustion section.

c. Turbine section.

d. Exhaust section.

e. Main engine bearings and seals.

f. Accessory drive section.

12-5. **COMPRESSOR SECTION.**

12-6. **Compressor Front Frame.** The compressor front frame forms the air inlet passage for the engine and supports the front of the compressor rotor. The frame consists of an outer shell, an inner hub, 8 evenly spaced hollow airfoil shaped struts, and the inlet guide vanes. See figure 12-2.

12-7. **Compressor Casing Assemblies.** The compressor casing assembly consists of 2 cylindrical steel casings split along a horizontal line. The front casing assembly contains 6 stages of variable vanes and the 7th-stage stator vanes.

12-8. **Compressor Rotor.** The compressor rotor consists of a front stub shaft, 17 discs and stages of blades, 16 spacers, a 7th-stage air baffle and ducts, 4 torque cones, a rear stub shaft and a rotating air seal.

12-9. **Compressor Rear Frame.** The compressor rear frame absorbs the thrust loading of the rotors and the radial force of the compressor turbine coupling. It also forms an annular diffuser for the compressor discharge air. The frame consists of an outer shell connected by 10 equally spaced, hollow, airfoil shaped struts to an inner shell. The outer shell provides 10 mounting pads for the fuel nozzles and 10 bosses for sleeve bolt inserts which are used to secure the combustion liners.

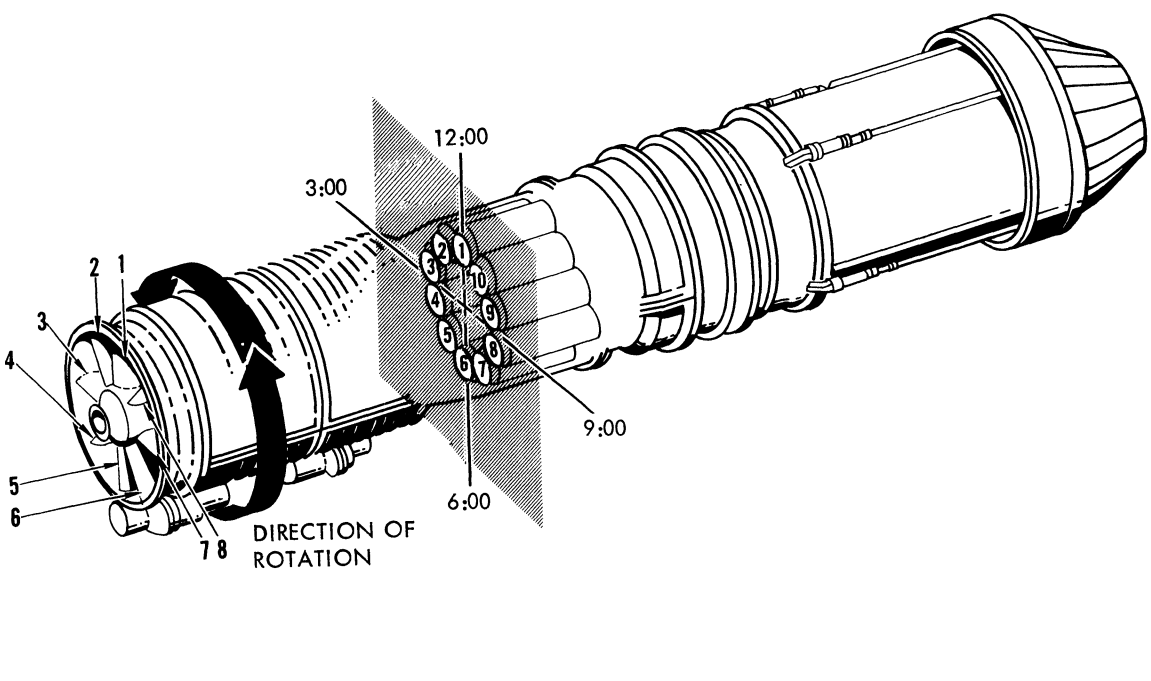


Figure 12-1. Basic Engine Views

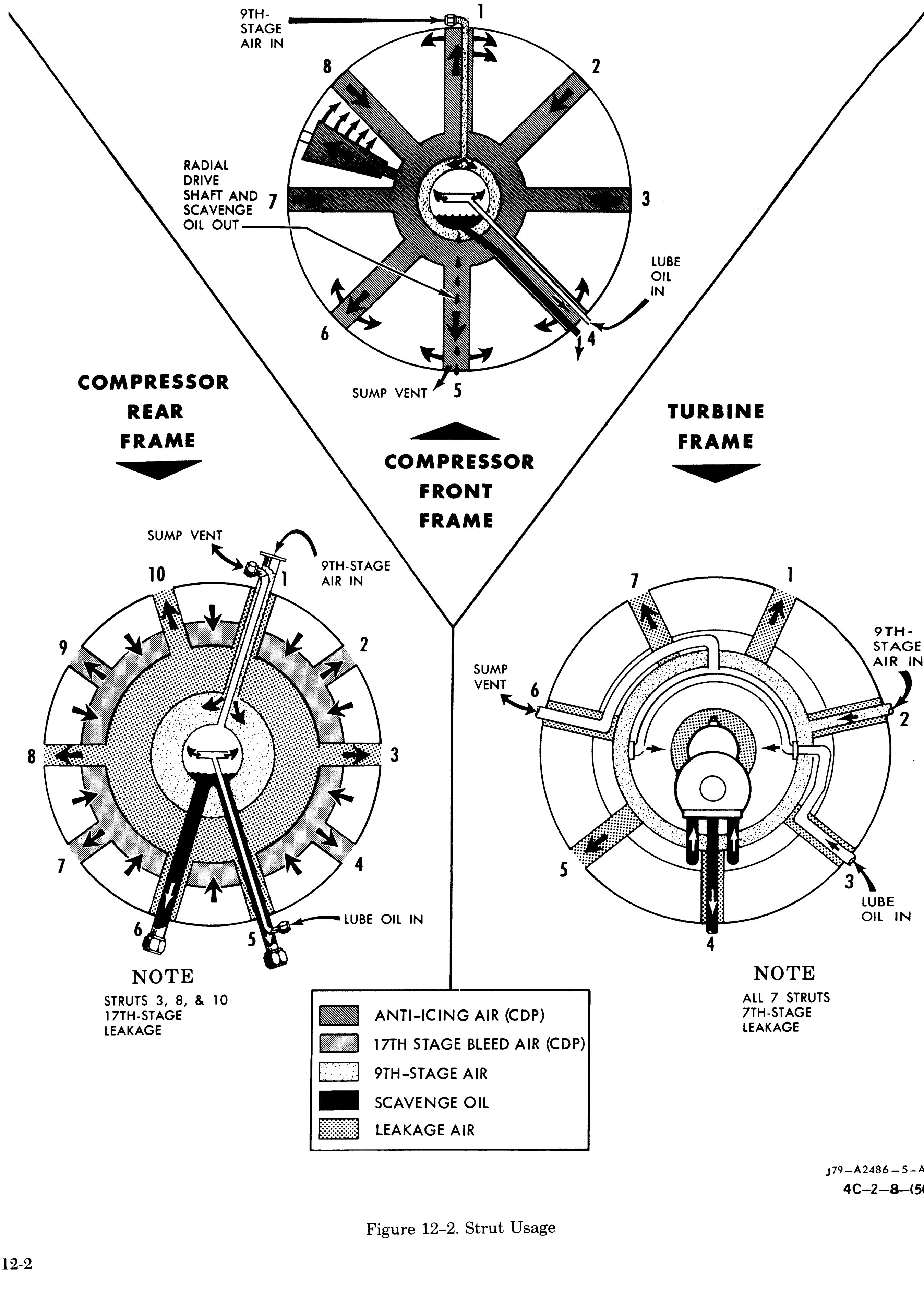


Figure 12-2. Strut Usage

12-10. **COMBUSTION SECTION.**

12-11. **Combustion Outer Casing.** The combustion outer casing is split on the horizontal line to permit removal of the casing for inspection and removal of the liners. The upper half contains a port at the top for extraction of anti-icing air. The lower half contains 2 spark plug bosses, one at the no. 4 liner and one at the no. 5 liner, a combustion system drain and an air extraction port.

12-12. **Combustion Liners.** Each combustion liner consists of an inner liner, an outer liner, and a rear liner. The outer liner forms a snout which scoops compressor discharge air into the liner. Vanes in the snout distribute the air uniformly around the dome of the inner liner. A slot in the snout permits the fuel nozzle to extend into the inner liner dome. The no. 4 and no. 5 liners each have a spark plug hole through the inner and outer liners.

12-13. **Combustion Inner Casing.** The inner casing bolts between the rear flange of the compressor rear frame inner shell and the 1st- stage turbine nozzle and the transition duct. It absorbs the torque developed on the turbine nozzle and it confines the combustion airflow to an annular passage around the liners. Holes near the front of the casing permit air to flow into the chamber around the turbine shaft to cool the shaft, and the 1st-stage turbine blade shanks.

12-14. **Annular Transition Duct.** The transition duct provides a ring of 10 oval inlet ports and an annular exit, the area of which is one half that of the total area of the inlets to accelerate the airflow into the 1st-stage nozzle. The duct is supported by the inner combustion casing.

12-15. **TURBINE SECTION.**

12-16. **First-Stage Turbine Nozzle.** The 1st-stage turbine nozzle is bolted to the rear flange of the inner combustion casing. The inner band of the nozzle is a one piece structure from which the vanes are cantilevered. The vanes are hollow, airfoil sections with cooling air passages.

12-17. **Turbine Stator Assembly.** The turbine stator is split on a horizontal line to permit it to be removed. It includes the 3 turbine shrouds, the 2nd and 3rd-stage nozzles and the 3rd stage turbine blade guard.

12-18. **Turbine Rotor.** The turbine rotor produces the necessary torque to drive the compressor. It consists of the turbine shaft, 3 turbine wheels and 3 sets of blades.

12-19. **Turbine Frame.** The turbine frame forms an exhaust diffuser, supports the rear of the turbine rotor, and provides the main engine to aircraft mounting structure. The frame consists of an outer cone, an inner cone, and a sump housing connected by 7 equally spaced, hollow struts. The struts are housed within turbine frame vanes to shield them from exhaust temperatures.

12-20. **EXHAUST SECTION.**

12-21. **Afterburner Assembly.** The afterburner assembly consists of the forward exhaust duct and liner, 4 fuel manifolds, 21 spraybars, an inner rear cone, flameholder, and torch igniter. The forward exhaust duct is bolted to the rear flange of the turbine frame.

12-22. **Tailpipe Assembly.** The tailpipe assembly consists of the rear exhaust duct, the no. 2, no. 3 and no. 4 liners and the exhaust nozzle. The liners are ceramic coated to withstand the high afterburner temperatures. The liners are corrugated and have cooling louvers to route cooling air along the inner surface of the liner.

12-23. **Exhaust Nozzle.** The exhaust nozzle assembly consists of nozzle flaps and seals interconnected by flap actuators and bellcranks to the support ring and shroud flaps and seals. The support ring telescopes into the outer shroud. Through this arrangement, movement of the support ring toward the rear of the engine causes a simultaneous increase in the opening area of the primary and secondary exhaust nozzles, and the spacing length between the nozzle throats.

12-24. **BEARINGS AND SEALS.**

12-25. **No. 1 Bearing Area.** The no. 1 bearing, which is housed in the compressor front frame, is a roller bearing and restrains radial loads only; thus it allows the rotor to expand axially without transmitting stress to the surrounding structure. The front gearbox is included in the sump area, so no engine oil and air seals appear in front of the no. 1 bearing. Behind the bearing is a dual, carbon rubbing type seal. 9th- stage air is contained in the area between the segment rows to pressure load the segments against the race to minimize oil leakage from the sump.

12-26. **No. 2 Bearing Area.** The no. 2 bearing, which is housed in the compressor rear frame, is a ball bearing and restrains both the radial and the thrust loading of the rotors. It is contained in a sump enclosed by carbon rubbing oil seals, which consist of a single row of carbon segments mounted in a housing and held circumferentially by a coil spring.

12-27. **No. 3 Bearing Area.** The no. 3 bearing, which is housed in the turbine frame, is a roller bearing and restrains radial loads only. The sump area is enclosed by carbon rubbing seals. The air pressure around the sump is confined by the rear turbine air seal and the rear no. 3 bearing air seal.

12-28. **ACCESSORY DRIVE SECTION.** See figures 12-3 and 12-4.

12-29. **Front Gearbox.** The front gearbox is housed within the hub of the front frame and is connected directly to the front stub shaft of the compressor rotor through a spline. It contains bevel gears which convert the power into a radial plane in which it is transmitted to the transfer gearbox by a radial drive shaft. The front flange provides a mount for the aircraft constant speed drive. The gearbox housing contains a passage at the top to supply anti-icing air to the engine nose dome from the front frame hub.

12-30. **Transfer Gearbox.** The transfer gearbox is mounted at the bottom of the compressor front frame, and receives power from the front gearbox through a radial drive shaft housed in the no. 5 strut of the frame. The gearbox converts a radial drive to several horizontal drives, and supplies the power to drive hydraulic pumps, fuel pumps, an engine control generator, a techometer generator, and an oil scavenge pump. A combination pneumatic and cartridge combustion starter is mounted on the rear face of the transfer gearbox.

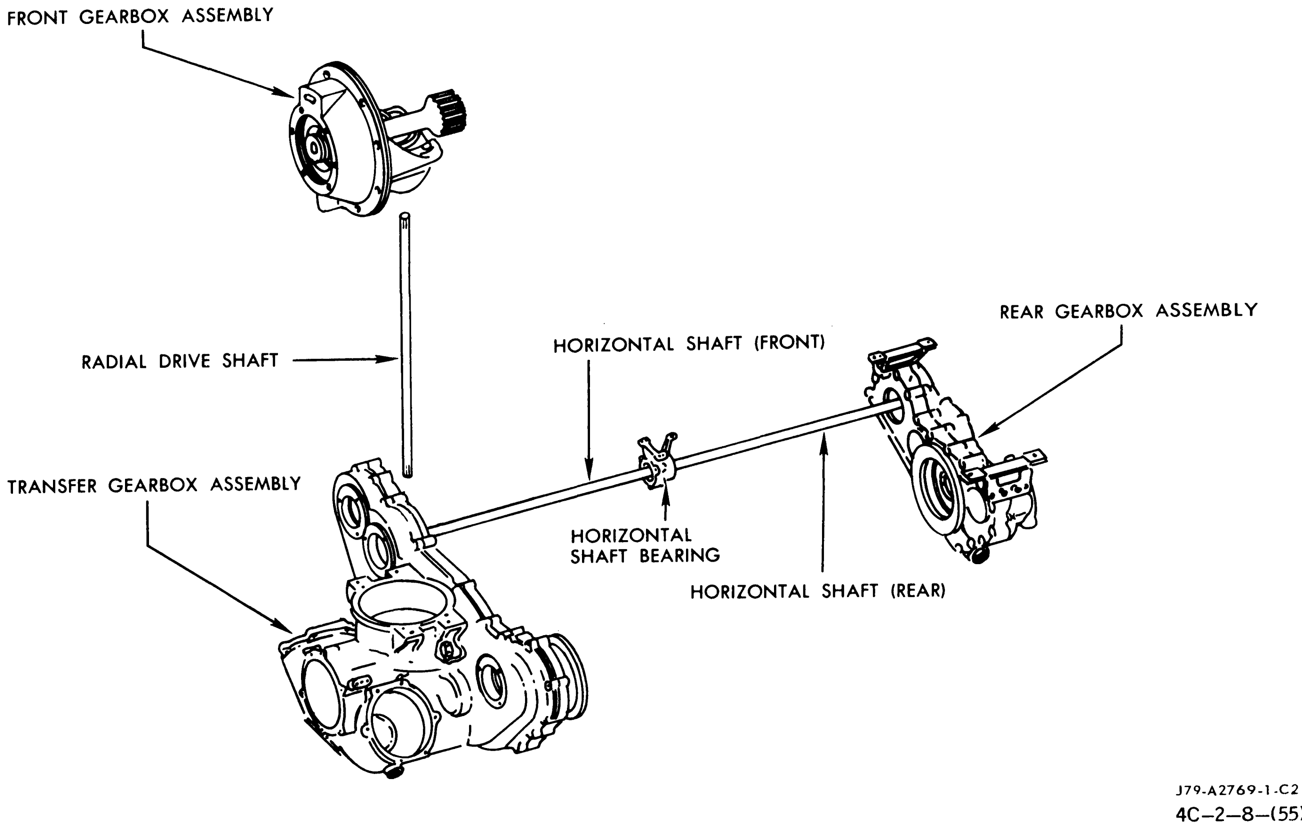


Figure 12-3. Accessory Drive

12-31. **Horizontal Drive Shaft Support Bearing.** The horizontal drive shaft support bearing is spline connected to the front and rear horizontal drive shafts to prevent deflection of the shafts. The bearing housing is bolted to the bottom of the front compressor casing ribs.

12-32. **Rear Gearbox.** The rear gearbox is attached to the bottom of the compressor rear casing and is hinge-mounted to compensate for the different rates of expansion between the casing and the gearbox. It supplies power to drive engine oil pumps, a hydraulic pump, and the main fuel control. It receives power from the transfer gearbox through the horizontal drive shaft.

THEORY OF OPERATION

12-33. GENERAL.

12-34. During operation, air enters the front of the engine and is directed into the compressor at the proper angle by the variable inlet guide vanes. The air is compressed and forced into the combustion section. A fuel nozzle extending into each combustion liner atomizes the fuel for combustion. The fuel-air mixture is initially ignited by 2 Ignitor plugs in 2 adjacent combustion liners, and is rapidly propagated to the remaining liners by cross ignition ducts which join adjacent liners. Once initiated, combustion is self-sustaining so ignition is turned off.

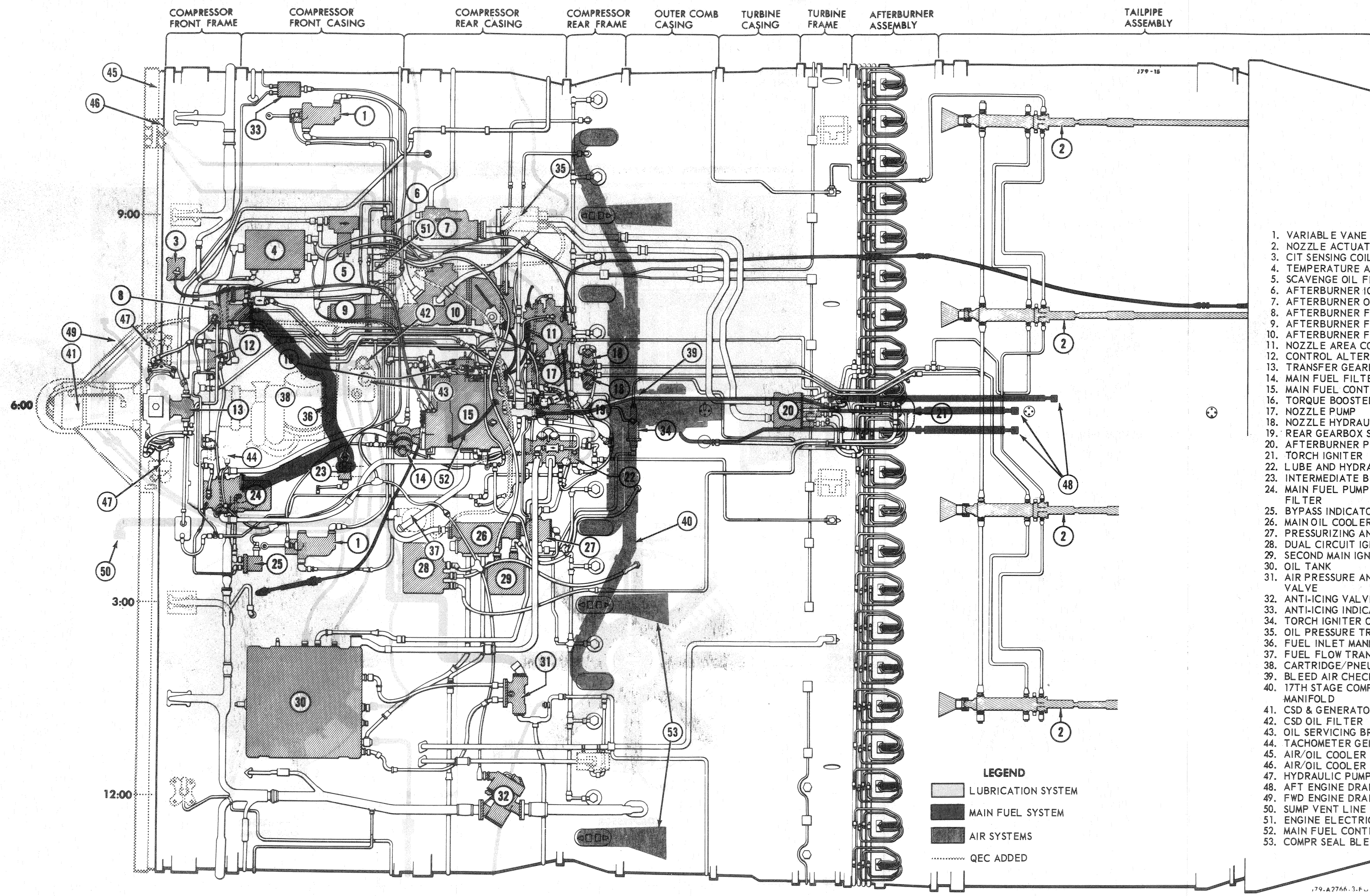
12-35. The gases which result from combustion are directed into the turbine, which drives the compressor rotor. From the turbine, the exhaust gases flow into the afterburner where additional fuel may be injected and ignited to augment the thrust of the main engine. The exhaust gases then pass through, and are accelerated by, the exhaust nozzle.

12-36. The engine systems control engine thrust by regulating engine speed, stator angle, fuel flow, exhaust nozzle area, and exhaust gas temperature. Interconnecting signals integrate the various controls so that the systems function as a single unit in response to the throttle.

12-37. **PRIMARY AIRFLOW.** See figures 12-5, 12-6, 12-6A, and 12-6B. The primary airflow pressurizes areas of the engine, cools engine assemblies and parts, and supports the combustion of fuel. As the primary airflow is traced through the compressor, combustion, turbine, and exhaust sections of the engine, its many functions are discussed.

12-38. During engine operation, air is drawn or rammed into the inlet, where it is directed onto the 1st-stage rotor blades by the inlet guide vanes. The successive stages of the compressor increase the pressure of the air, while forcing it to the rear. The angles of the first 6 stages of stator vanes and the inlet guide vanes are variable to maintain the efficiency of the compressor over a wide range of operating conditions.

12-39. The acceptable pressure rise of each stage of the compressor depends upon the speed of rotation of the rotor, which is reflected by engine speed; the density of the air, which is reflected by compressor inlet temperature; and the angle at which the air strikes the blades and vanes. The position of the vanes during any engine speed/compressor inlettemperature condition is established by the main fuel control.



1. VARIABLE VANE ACTUATOR
2. NOZZLE ACTUATOR
3. CIT SENSING COIL
4. TEMPERATURE AMPLIFIER
5. SCAVENGE OIL FILTER
6. AFTERBURNER IGNITION SWITCH
7. AFTERBURNER OIL COOLER
8. AFTERBURNER FUEL PUMP
9. AFTERBURNER FUEL FILTER
10. AFTERBURNER FUEL CONTROL
11. NOZZLE AREA CONTROL
12. CONTROL ALTERNATOR
13. TRANSFER GEARBOX SCAVENGE PUMP
14. MAIN FUEL FILTER
15. MAIN FUEL CONTROL
16. TORQUE BOOSTER
17. NOZZLE PUMP
18. NOZZLE HYDRAULIC FILTER
19. REAR GEARBOX SCAVENGE PUMP
20. AFTERBURNER PRESSURE VALVE
21. TORCH IGNITER
22. LUBE AND HYDRAULIC PUMP
23. INTERMEDIATE BEARING HOUSING
24. MAIN FUEL PUMP AND LOW PRESSURE FILTER
25. BYPASS INDICATOR SWITCH
26. MAIN OIL COOLER
27. PRESSURIZING AND DRAIN VALVE
28. DUAL CIRCUIT IGNITION UNIT
29. SECOND MAIN IGNITION UNIT
30. OIL TANK
31. AIR PRESSURE AND VACUUM RELIEF VALVE
32. ANTI-ICING VALVE
33. ANTI-ICING INDICATOR SWITCH
34. TORCH IGNITER ON-OFF VALVE
35. OIL PRESSURE TRANSMITTER
36. FUEL INLET MANIFOLD
37. FUEL FLOW TRANSMITTER
38. CARTRIDGE/PNEUMATIC STARTER
39. BLEED AIR CHECK VALVE
40. 17TH STAGE COMPR BLEED AIR MANIFOLD
41. CSD & GENERATOR UNITS
42. CSD OIL FILTER
43. OIL SERVICING BRACKET
44. TACHOMETER GENERATOR
45. AIR/OIL COOLER
46. AIR/OIL COOLER VALVE
47. HYDRAULIC PUMPS
48. AFT ENGINE DRAIN LINES
49. FWD ENGINE DRAIN LINES
50. SUMP VENT LINE
51. ENGINE ELECTRICAL CONNECTORS
52. MAIN FUEL CONTROL DRAIN
53. COMPR SEAL BLEED AIR DEFLECTORS

4C-2-8-(57)
R Y B

Figure 12-4. Outside Piping

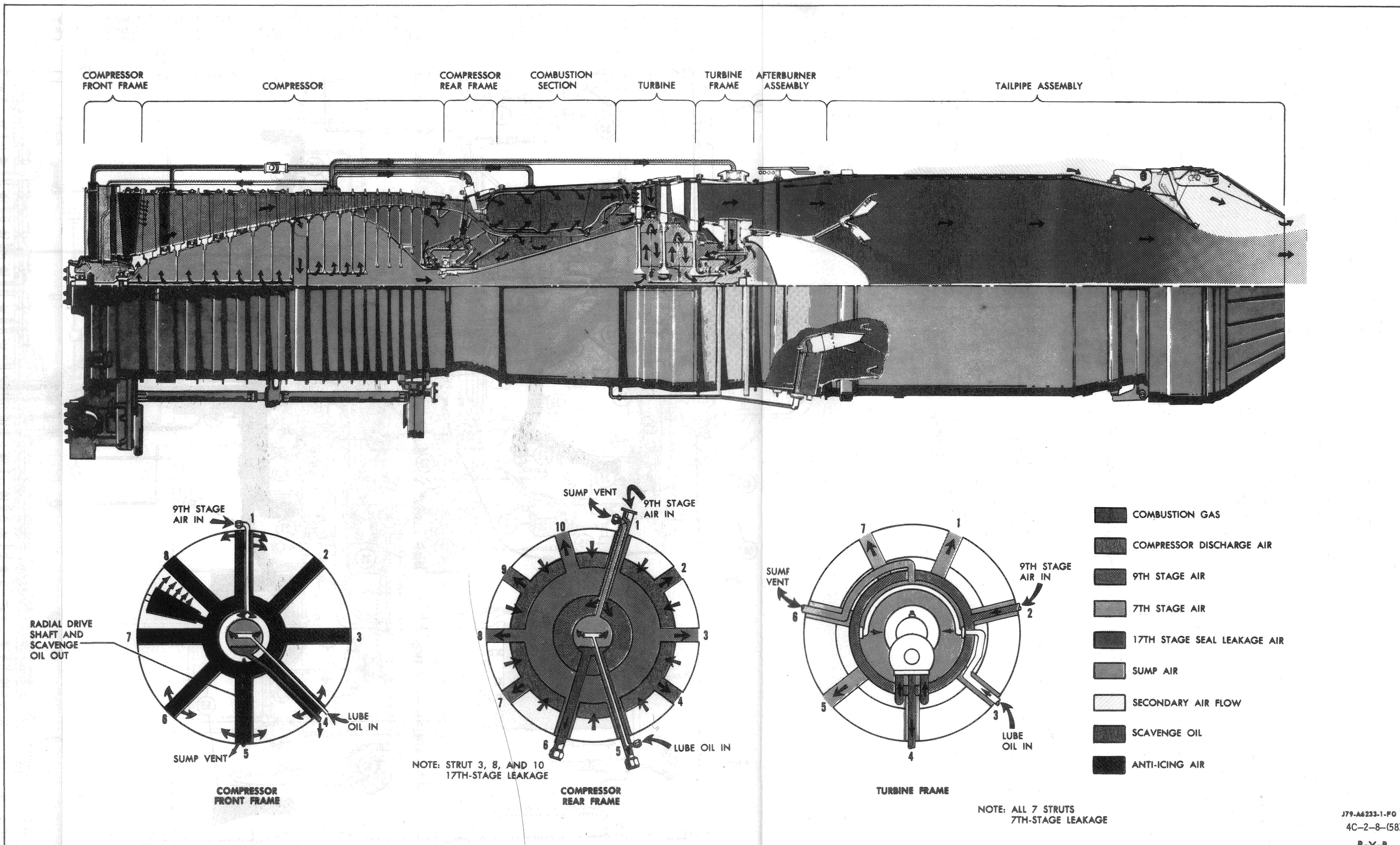
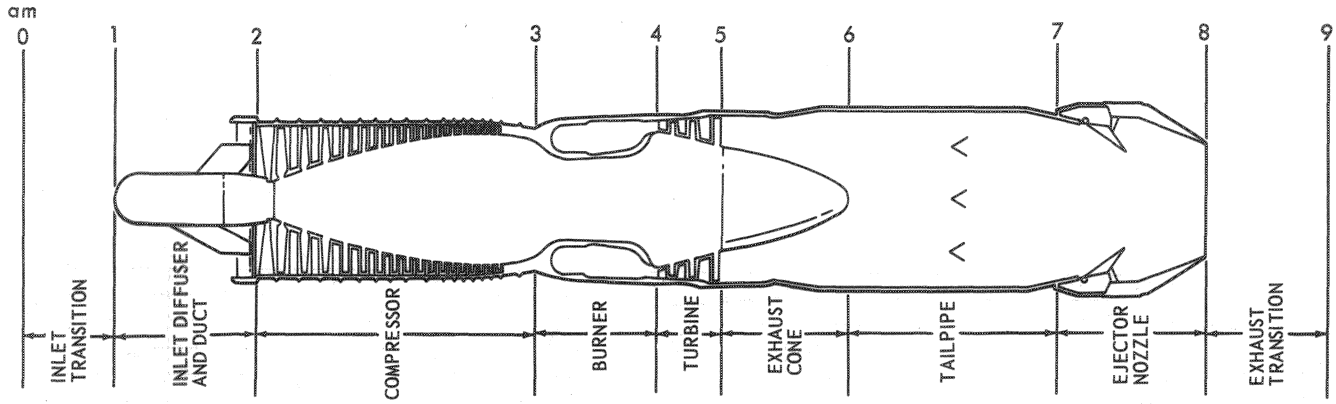


Figure 12-5. Power Plant Airflow



STATION DESIGNATIONS	
STATION	DEFINITION
am	AMBIENT
0	FREE STREAM
1	ANY POINT OF REFERENCE FORWARD OF THE COMPRESSOR
2	COMPRESSOR INLET
3	COMPRESSOR OUTLET
4	TURBINE INLET
5	TURBINE OUTLET
6	TAILPIPE INLET (UPSTREAM OF AFTERBURNER)
7	TAILPIPE OUTLET (JET NOZZLE INLET)
8	JET NOZZLE OUTLET
9	ANY POINT OF REFERENCE AFT OF NOZZLE OUTLET

PERFORMANCE SYMBOLS		
SYMBOL	DEFINITION	UNIT
F	THRUST	LB
Fg	GROSS THRUST, INCLUDING THE EFFECTS OF SECONDARY (EJECTOR) AIRFLOW, WHEN APPLICABLE	LB
Fn	NET JET THRUST = Fg - Fr	LB
Fr	RAM DRAG, INCLUDING SECONDARY (EJECTOR) AIRFLOW WHEN APPLICABLE	LB
g	ACCELERATION DUE TO GRAVITY	FT/SEC^2
Mo	FLIGHT MACH NO., FREE STREAM MACH NO.	
N	ENGINE ROTOR SPEED	RPM
P	ANY GAS STATIC PRESSURE, ABSOLUTE	PSI
Psls	STANDARD SEA LEVEL STATIC PRESSURE, ABSOLUTE	PSI
Ps	FREE STREAM STATIC PRESSURE, ABSOLUTE	PSI
Pt	ANY GAS TOTAL PRESSURE, ABSOLUTE	PSI
Pt2/Po	RAM PRESSURE RATIO	
T	ANY GAS STATIC TEMPERATURE	°RANKINE
Tsls	STANDARD SEA LEVEL STATIC TEMPERATURE	°RANKINE
To	FREE STREAM STATIC TEMPERATURE	°RANKINE
Tt	ANY GAS TOTAL TEMPERATURE	°RANKINE
V	VELOCITY	FPS
Wa	AIRFLOW RATE	LB/SEC
Wf	FUEL LOW RATE	LB/SEC
Wg	GAS FLOW RATE	LB/SEC
Ws	SECONDARY AIRFLOW RATE (FOR EJECTOR)	LB/SEC

NOTE

THE SYMBOLS SHOWN HAVE A REFERENCE TO TEMPERATURE, PRESSURE, FLOWS, ETC WHICH AFFECT A CORRESPONDING SECTION OR FUNCTION OF AN ENGINE. NUMERICAL STATION DESIGNATIONS ARE ASSIGNED TO FACILITATE SPECIFIC REFERENCES TO THE VARIOUS SECTIONS OF THE ENGINE WHEN SUCH REFERENCE IS NEEDED FOR DESIGN AND/OR ADJUSTMENTS TO ENGINE OPERATION.

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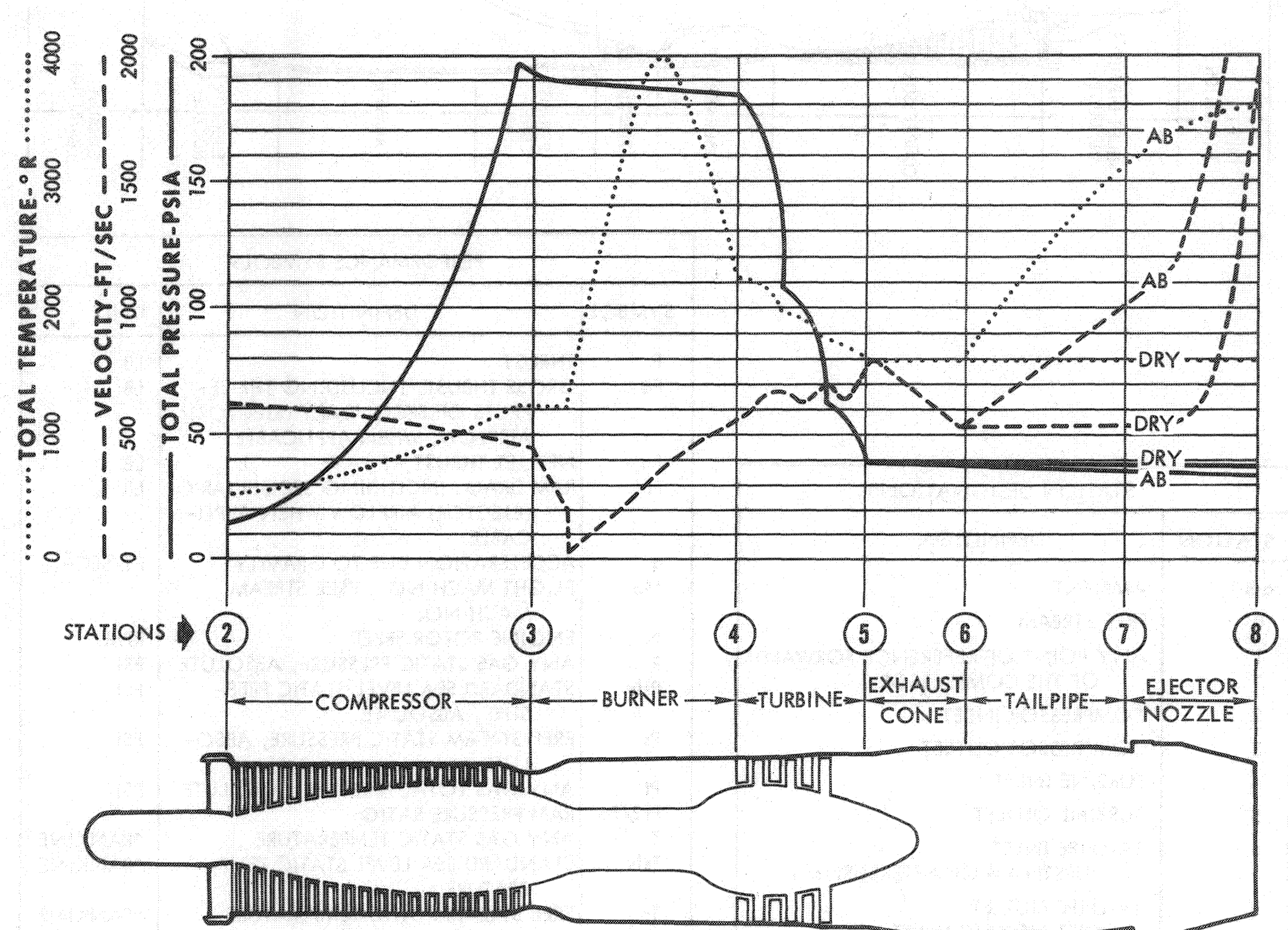
Figure 12-6. Power Plant Station Designation

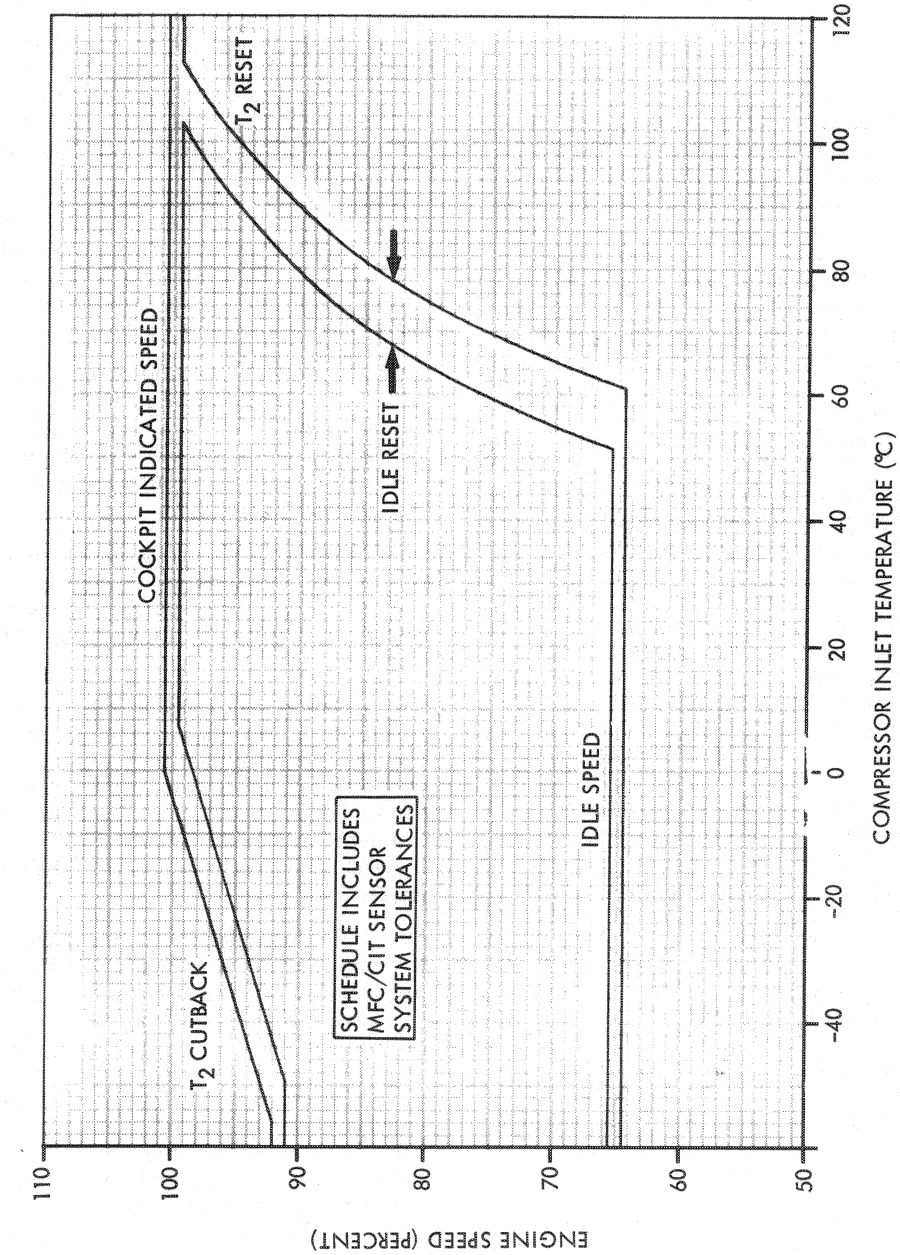


NOTE

TO CONVERT RANKINE TO FAHRENHEIT
°RANKINE = F° + 460

4C-2-8-(4)

Figure 12-6A. Velocity-Pressure-Temperature Profile



J79-FL-226-2
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Figure 12-6B. Engine Speed Schedule

12-40. As the air travels rearward, some of it bleeds inward through holes in the 7th-stage rotor spacer, and some outward through holes in the 9th-stage stator vane bases in the upper casing half. The 7th-stage air extraction is used as pressure equalization air within the compressor rotor and as turbine rotor cooling air. The 9th-stage air extraction becomes sump cooling and oil seal loading air for the 3 bearing sumps.

12-41. As the air leaves the rear of the compressor, it is straightened by the exit guide vanes to prevent swirling in the combustion section. The compressor rear frame is a diffuser, which decreases the air velocity and increases the pressure. The rear frame contains air extraction manifolds to supply air to the aircraft.

12-42. The air within the combustion section supports the combustion of fuel and cools engine assemblies. A snout on each of the combustion liners directs air into the outer liners. The vanes in the snout distribute the air uniformly around the domes of the inner liners. Some of the air passes through the cowls on the fuel nozzles to hold the flame away from the nozzle tips, some through the louvers in the dome of the inner liners to mix with the atomized fuel, and some through louvers in the sides of the liners to prevent the flame from contacting the inner surface of the liners. Thimble holes in the inner liners direct the air inward to center the flame.

12-43. The remainder of the air continues to flow rearward, surrounding the combustion liners. A small amount flows inward, through holes in the inner combustion casing, to cool the turbine shaft. It flows across a baffle on the inner rim of the 1st-stage turbine nozzle and onto the front face of the 1st-stage turbine blade shanks.

12-44. Air enters through louvers in the combustion rear liners, to prevent the flame from contacting the inner surface, and through thimble holes, to ensure complete combustion. Combustion is completed at a point early enough to prevent the flame from being directed onto the 1st-stage turbine nozzle vanes. The air surrounding the combustion liners cools the outer surface of the annular transition duct and some of it passes through louvers between the ports of the duct.

12-45. Air flows through baffles on the rear flange of the combustion liners and along the inner surface of the annular transition duct ports. It also flows through baffles on the rear of the transition duct and flows over the inner and outer bands of the 1st-stage turbine nozzle.

12-46. Some air enters the outer end of the 1st-stage nozzle vanes, passes inward through the vanes, and is directed onto the front of the 1st-stage turbine blade shanks. Some air continues to flow rearward through holes in the inner rib of the turbine casing and inward through the 2nd-stage turbine nozzle vanes. It is directed onto the rear of the 1st-stage turbine blade shanks.

12-47. The 1st-stage nozzle vanes increase the velocity of the combustion gases and direct them onto the 1st-stage turbine blades. The 2nd-stage vanes reduce the swirling, again incrase the velocity of the gases, and direct them onto the 2nd-stage blades. The 3rd-stage vanes reduce the swirling, accelerate the gases, and direct them onto the 3rd-stage blades. The energy extracted, as a reaction to the high velocity air striking the blades, produces the rotary motion that drives the compressor and accessories.

12-48. Turbine shrouds and seals prevent excessive leakage of gases around the tips of the blades, and over the torque rings of the rotor. Strut covers, surrounding the struts of the turbine frame, reduce the swirling of the gases entering the exhaust section. The turbine frame diffuses the air as it enters the exhaust section.

12-49. Thermocouples, mounted in the turbine frame, produce an electrical signal that is proportional to the temperature of the turbine discharge (exhaust gas) temperature. The signal is used for cockpit indication and for control of the exhaust nozzle area.

12-50. The air in the exhaust section is diffused between the rear inner cone and the exhaust duct. The air is divided into cooling air, which flows between the liners and the duct, and exhaust air, which flows through the liners. The cross-section of the air stream changes from annular to circular within the duct.

12-51. Spraybars, extending into the exhaust air stream, add fuel which is ignited to augment the thrust of the basic engine. The flameholder produces a turbulence that enhances burning of the fuel. The pilot burner, receiving its air supply from the outer combustion casing, maintains the flame.

12-52. The cooling air, between the liners and the ducts, passes through louvers in the liner to shield its inner surface from direct contact with the afterburner flame. It also flows along the inner surface of the primary nozzle flaps and seals.

12-53. The exhaust nozzle causes the velocity of the air stream to increase by restricting its flow. The velocity of the exhaust gases past the throat (smallest) area is limited to the speed of sound within the gases. Since the speed of sound increases in proportion to an increase in temperature, the afterburner produces thrust by increasing both the temperature and the velocity of the gases.

12-54. The converging portion of the nozzle, formed by the primary flaps, accelerates the gases to a sonic velocity. The diverging portion of the nozzle, formed by secondary air directed by the shroud flaps, controls the rate of expansion, and thus in effect accelerates the gases beyond the throat. The nozzle area is determined by the throttle position until the temperature of the exhaust gases reaches the reference temperature schedule of the engine; then throttle control of the nozzle is over ridden by a temperature limiting system to maintain the exhaust gas temperature according to the reference temperature schedule. The high velocity of the exhaust gases passing from the throat of the nozzle to the exit acts as an aspirator to cause air to flow along the outside of the engine. This is called secondary air.

12-55. **SECONDARY AIRFLOW.** The secondary air cools the engine and accessories and forms the diverging (aerodynamic) exhaust nozzle. The air enters the engine compartment, passes along the outside of the engine and removes any fumes or leakage air from the engine compartment. The air is drawn into the outer shroud, between the primary and the secondary (shroud) nozzle flaps, and forms a nozzle around the expanding exhaust gases. The air mixes with the primary air and increases the total amount of airflow. The secondary air controls the rate of expansion of the exhaust gases beyond the primary nozzle throat and also lowers its temperature. The shroud

flap seals, and a seal between the fuselage and the outer shroud, reduce secondary air leakage, which would reduce aircraft performance.

12-56. **AIR EXTRACTION.** Air is extracted from the compressor for many uses; such as turbine cooling, sump cooling, anti-icing, and other aircraft requirements. Some air passes inward through holes in the 7th-stage rotor spacer. It is ducted throughout the rotor to equalize the air pressure on the discs. It passes through the rear stub shaft and into the turbine shaft to cool the shaft and the front of the 1st-stage turbine wheel; the air flows through the center of the 1st-stage wheel, outward on the rear face of the wheel, across the inside of the 1st-stage torque ring, and inward on the front face of the 2nd-stage wheel; the air flows through the center of the 2nd-stage wheel, outward on the rear face of the wheel, across the inside of the 2nd-stage torque ring, and inward on the front face of the 3rd-stage wheel; it then flows through the center of the wheel, into the turbine cooling air baffle; and outward through all 7 struts of the rear frame, into the engine compartment.

12-57. Sump cooling and oil seal pressurization air for the 3 bearing areas flows outward from the compressor into the 9th-stage air manifold. It is externally piped to a tube in the No. 1 strut of the compressor front frame, a tube in the No. 1 strut of the compressor rear frame, and to one in the No. 2 strut of the turbine frame. The sump cooling air is confined to the compressor rear frame cavity by the No. 2 bearing front and rear air seals. The air minimizes oil leakages from the bearings sumps and, in addition, it surrounds the No. 2 bearing sump to isolate the sump from the heat of compressor discharge air. The air that leaks across the oil seals enters the bearing sump. The air that leaks across the air seals enters the 17th-stage seal leakage air cavity.

12-58. The cooling air is confined in the cavity of the turbine frame by the rear turbine air seal at the front and the no. 3 bearing air seal at the rear. The air seal leakage air enters the turbine discharge air from the front seal and the turbine cooling air at the rear seal.

12-59. Air for use in the aircraft is extracted from the compressor discharge. The air enters the stiffening manifolds in the compressor rear frame inner shell and is ducted through the no. 2, 4, 7, and 9 struts of the rear frame.

12-60. **ANTI-ICING AIR.** The anti-icing air prevents or removes ice formation in the engine inlet. The air is extracted through a port at the top of the combustion section outer casing, and is piped to the anti-icing valve, which regulates the flow and pressure. From the valve it is piped to the 1st-stage stator anti-icing manifold and to pads on the front frame, where it is ducted into the hub by 4 struts. The air is confined by a manifold cover in the hub of the frame and is distributed through the hollow shanks of the inlet guide vanes and the remaining 4 struts of the front frame. The gearbox housing contains a passage at the top to supply anti-icing air to the engine nose dome from the front frame hub. An indicator switch illuminates a light in the cockpit to indicate that anti-icing air is on. The switch contacts close when the anti-icing duct pressure exceeds comperssor inlet pressure by 2.5 $\pm$0.2 psi.

TOOLS AND TEST EQUIPMENT

12-61. GENERAL.

12-62. To perform maintenance on the system or components, the special tools and test equipment listed in Table 12-1 should be used. Alternate equipment with equal or greater range and accuracy than that in the Alternate Equipment column may be substituted. The listed tools and test equipment are for performing aircraft and shop maintenance procedures in this section of the manual.

Table 12-1. Tools and Test Equipment

Name	Identification No.	Alternate Equip. Range	Alternate Equip. Accuracy	Use
Adapter, support nozzle assembly, exhaust ejector	1C2770			To aid installation of tailpipe assembly.
Socket wrench	1C3716			To aid in removing afterburner.
Extension sling	1C2759 or 1C5269G2			To support tailpipe during removal.
Wrench	1C2667			To remove AB flange nuts.

AIRCRAFT MAINTENANCE

12-63. **GENERAL INFORMATION.**

12-64. **CIRCUIT BREAKERS.** Refer to section II.

12-65. **MAINTENANCE CONCEPT.** Organizational maintenance of the basic power plant in this section of the manual consists primarily of visual inspection of the power plant. Checkout, trouble analysis, and replacement and adjustment of components are covered in other sections of the manual.

12-66. **CHECKOUT PROCEDURES.**

12-67. Refer to T.O.2J-J79-46, for checkout procedures applicable to the basic power plant.

12-68. **TROUBLE ANALYSIS.**

12-69. Refer to section II, for trouble analysis applicable to the basic power plant systems.

12-70. **REMOVAL AND INSTALLATION.**

12-71. Refer to T.O.1F-4C-6 for all inspection intervals, inspection schedules, special inspections and overhaul intervals applicable to the J79 basic engine.

12-72. **VISUAL INSPECTION OF THE POWER PLANT.** See figures 12-7 thru 12-18. The following inspection limits are intended to aid the maintenance personnel to determine whether an engine part is acceptable for continued service or should be returned to a field maintenance activity for repair or replacement. In most cases, the limits are liberal; however, in areas where the possibility for rapid growth of cracks could cause failure of parts, the limits are stringent.

NOTE

If damage exceeds the limits on figure 12-7, return engine to field maintenance activity for a detailed inspection of compressor, with compressor upper rear casing removed.

12-73. Inspection of the engine consists chiefly of visual inspection of the external engine surfaces and those portions of the compressor and exhaust section which can be seen by looking up the compressor inlet and exhaust nozzle (use of a strong shaded light is recommended) with the engine installed. No rework procedures are included in the following illustrations. The only parts authorized for replacement at this level are the accessories, the inner rear exhaust cone, and the flameholder, afterburner manifold, spraybars, and component parts of exhaust nozzle assembly where feasible. For repair or replacement of other parts, return the engine to a field maintenance activity.

NOTE

If any stator vane pins are missing return engine to Intermediate Maintenance.

12-74. **Inlet Guide Vanes, Variable Vanes and Rotor Blades.** Inspect the first through tenth stage stator and rotor blades for damage as outlined in figures 12-7 and 12-8.

12-75. **Compressor Section.** Inspect the compressor section for damage as outlined in T.O.2J-J79-46.

12-76. **Combustion Section.** Inspect the combustion section for damage as outlined in T.O.2J-J79-46.

12-77. **Turbine Casing.** Inspect the outer surface of the turbine casing for damage as outlined in T.O.2J-J79-46.

12-78. **Turbine Frame.** Inspect the turbine frame for damage as outlined in T.O.2J-J79-46.

12-79. **Torch Igniter.** Inspect the torch igniter for damage as outlined in figure 12-13.

12-80. **Flameholder.** Inspect the flameholder for damage as outlined in figure 12-14.

12-81. **Afterburner Manifold and Spraybars.** Inspect the afterburner manifold and spraybars for damage as outlined in figure 12-15.

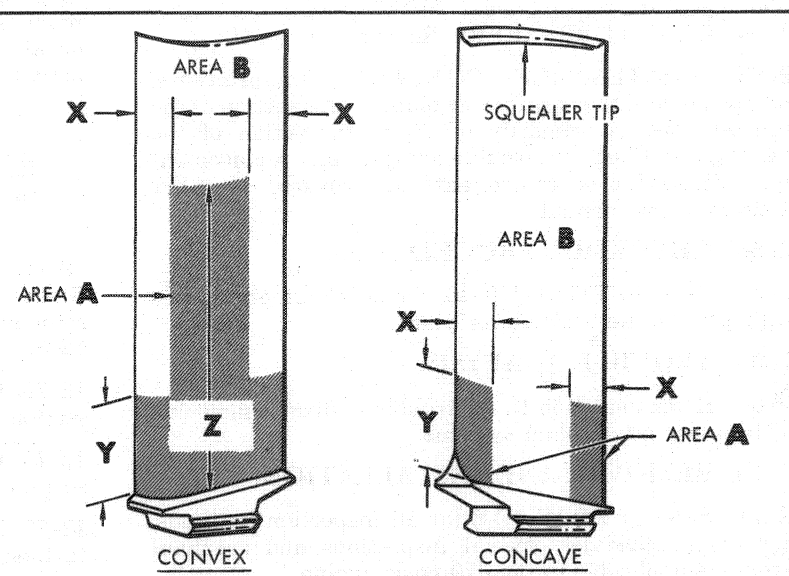
12-82. **Inner Rear Cone.** Inspect the inner rear cone for damage as outlined in figure 12-16.

12-83. **Forward and Rear Exhaust Duct.** Inspect the forward and rear exhaust ducts for damage as outlined in figure 12-17.

12-84. **Variable Nozzle.** Inspect the variable nozzle assembly for damage as outlined in figure 12-18.

12-85. **Turbine Blade.** Inspect turbine blades for damage which would indicate a failed 1st stage turbine blade as outlined in T.O. 2J-J79-46.

STAGE	DIM X	DIM Y	DIM Z
1	1/2	2	6 1/8
2	1/2	2	5 1/4
3	1/2	1	4 1/2
4	3/8	1/2	4
5	3/8	1/2	3 1/2
6	3/8	1/4	3
7	1/4	1/4	2 5/8
8	1/4	1/4	2 1/4
9	1/4	1/4	2
10	3/16	1/4	1 3/4
DIMENSIONS IN INCHES			



FIRST THROUGH TENTH STAGE BLADES

INSPECT	MAX. SERVICEABLE LIMITS
FIRST THROUGH TENTH STAGE ROTOR BLADES	
All Areas for:	
CRACKS OR TORN METAL	Not serviceable
DAMAGED OR MISSING COATING	Any amount
TIP CURL	½ blade width down from blade tip — no limit across blade tip
SQUEALER TIP DAMAGE	Any amount
CORROSION, PITTING	Not to exceed nick limits
Contour Area for:	
NICKS	
AREA "A"	Stages 1 through 10: Any number 1/64 inch deep
AREA "B"	Stages 1 through 9: Any number 1/32 inch deep
	Stage 10: Any Number 1/64 inch deep
DENTS	
AREA "A"	Stages 1 through 10: Any number 1/64 inch deep
AREA "B"	Stages 1 through 9: Any number 1/16 inch deep
	Stage 10: Any number 1/32 inch deep

INSPECT	MAX. SERVICEABLE LIMITS
SCRATCHES	
AREA "A" AND B"	Any number 1/64 inch deep; any length longitudinally, ¼ blade width transversely
Leading and Trailing Edges for:	
NICKS AND DENTS	
AREA "A"	Stages 1 through 10: Any number 1/64 inch deep
AREA "B"	Stages 1 through 10: Any number 1/16 inch deep

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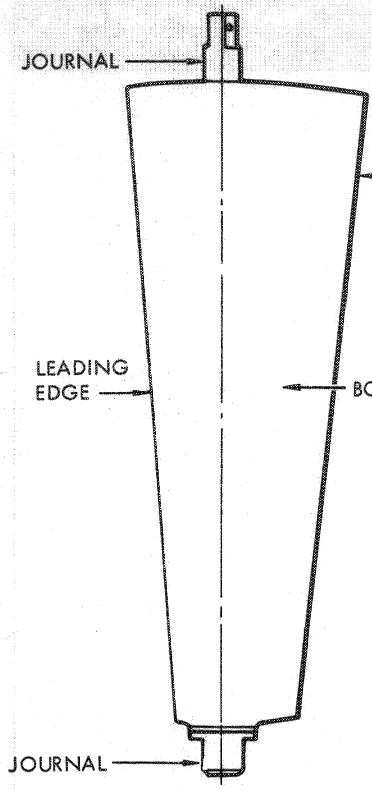
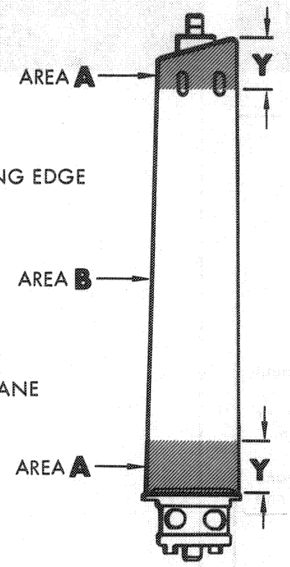
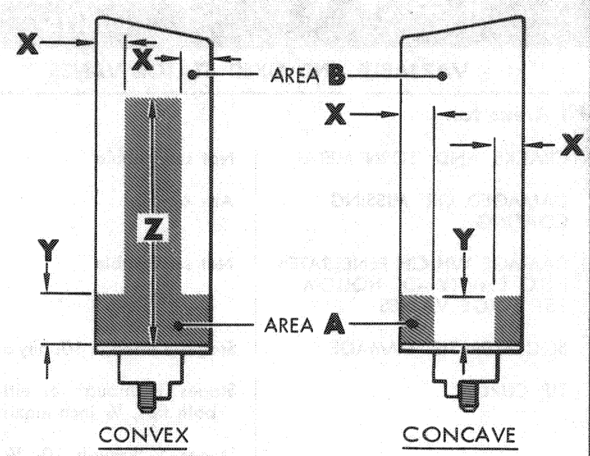
Figure 12-7. First Through Tenth Stage Rotor Blade Limits



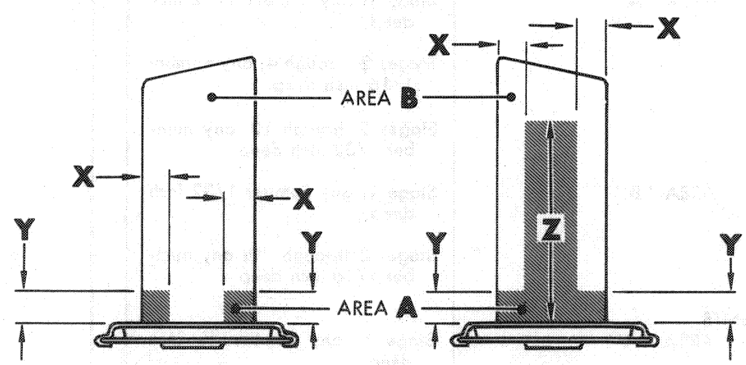
INLET GUIDE VANES



FIRST THROUGH FOURTH STAGE VARIABLE VANE



FIFTH AND SIXTH STAGE VARIABLE VANES



FIXED VANES

STAGE	DIM X	DIM Y	DIM Z
1	----	1	----
2-4	----	3/4	----
5	1/4	1/2	3 1/2
6	1/4	1/2	3
7	1/4	1/2	2 7/16
8	1/4	1/2	2 1/8
9	1/4	1/2	1 7/8
10	3/16	3/8	1 5/8

DIMENSIONS IN INCHES

INSPECT	MAX. SERVICEABLE LIMITS
INLET GUIDE VANES	
Inlet Guide Vanes for:	
PITS	Any number, 0.020 inch diameter
NICKS AND SCRATCHES	Any number, to 0.020 inch deep after removal of high metal
OBVIOUS DISTORTION AS DETERMINED VISUALLY	Not serviceable
DENTS IN LEADING EDGE OF VANE	Any number, 1/16 inch deep; other dents, ⅛ inch deep, if they are separated by 2 inches

INSPECT	MAX. SERVICEABLE LIMITS
DENTS IN BODY (CONTOUR) OF VANE	Any number, 1/32 inch deep; 5 other dents, 1/16 deep on each side of vane, if not directly opposite each other
DENTS IN TRAILING EDGE OF VANE	Any number, 1/16 inch deep; other dents, 5/32 inch deep, if separated by 2 inches
CRACKS	Not serviceable

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4C-2-8-(182-1)

Figure 12-8. First Through Tenth Stage Stator Blade Limits (Sheet 1 of 2)

INSPECT	MAX. SERVICEABLE LIMITS
VARIABLE AND FIXED STATOR VANES	
All Areas for:	
CRACKS AND TORN METAL	Not serviceable
DAMAGED OR MISSING COATING	Any amount
DAMAGE WHICH PENETRATES INTO CAVITY OF HOLLOW 1ST STAGE VANES	Not serviceable
SQUEALER TIP DAMAGE	Stages 5 through 10: any amount
TIP CURL	Stages 1 through 4: either or both tips, ⅛ inch maximum
	Stages 5 through 10: ½ vane width, maximum, from vane tip
CORROSION OR PITTING	Not to exceed nick limits
Contour Area for:	
NICKS	
AREA "A"	Stage 1: any number 1/32 inch deep
	Stages 2 through 4: any number 1/16 inch deep
	Stages 5 through 10: any number 1/32 inch deep
AREA "B"	Stage 1: any number 1/32 inch deep
	Stages 2 through 10: any number 1/16 inch deep
DENTS	
AREA "A"	Stage 1: any number ⅛ inch deep
	Stages 2 through 4: any number 1/16 inch deep
	Stages 5 through 10: any number 1/32 inch deep
AREA "B"	Stage 1: any number ⅛ inch deep
	Stages 2 through 10: any number 1/16 inch deep
SCRATCHES	
AREAS "A" AND "B"	Stage 1: 1/64 inch deep
	Stages 2 through 10: 1/32 inch deep

INSPECT	MAX. SERVICEABLE LIMITS

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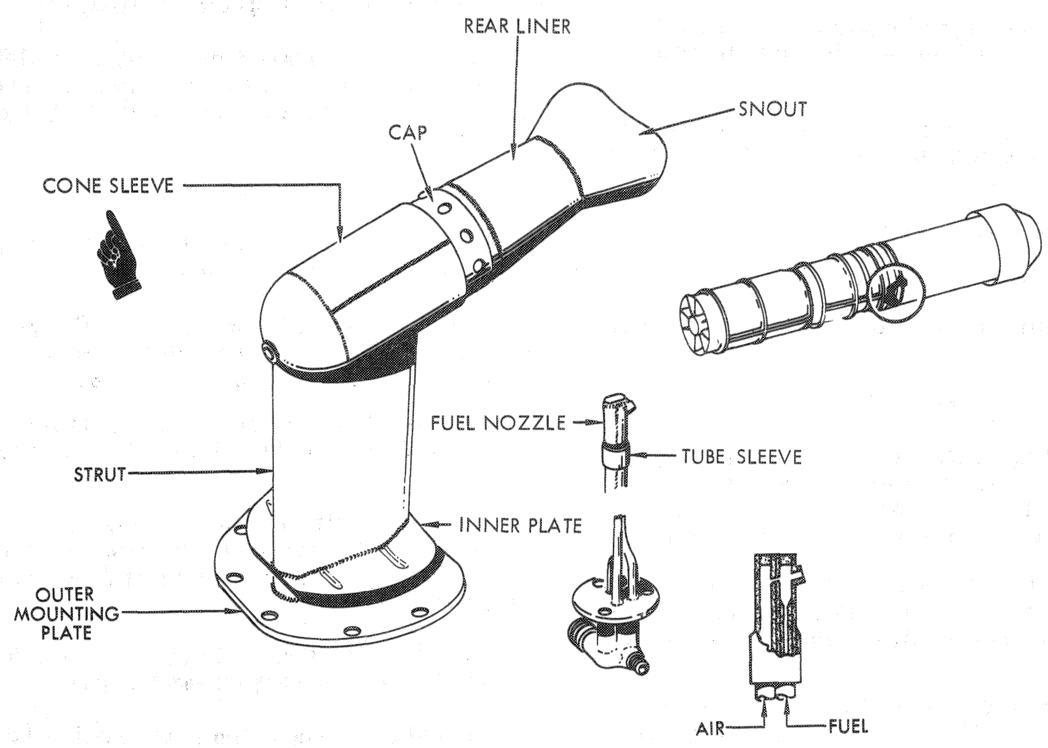
4C-2-8-(182-2)

Figure 12-8. First Through Tenth Stage Stator Blade Limits (Sheet 2 of 2)

"Figures 12-9, 12-10, 12-11 and 12-12 deleted."



INSPECT	MAX. SERVICEABLE LIMITS
TORCH IGNITER	
Spark Plug Boss for:	
FILLET WELD CRACKS	One crack, ¼ inch long
Outer Mounting Plate for:	
PARENT METAL CRACKS	1 ½ inch cumulative length
MOUNTING PLATE TO FUEL NOZZLE PAD FILLET WELD CRACKS	One crack, 1 ½ inch long or any number of small cracks up to 1 ½ inch total length
MOUNTING PLATE TO SPARK PLUG BOSS FILLET WELD CRACKS	¾ inch cumulative length
Cone for:	
PARENT METAL CRACKS	2 cracks, 3/16 inch long
BUTT WELD CRACKS	2 cracks, ¼ inch long
CONE TO STRUT FILLET WELD CRACKS	One crack, ½ inch long or any combination of cracks not exceeding ⅝ inch total length
LIP BURNING	7/32 inch back, and around 60 percent of the circumference
DENTS AND DISTORTION	⅛ inch from original contour as long as part can be assembled

INSPECT	MAX. SERVICEABLE LIMITS
Strut for:	
PARENT METAL CRACKS	2 cracks, 3/16 inch long
TRAILING EDGE CRACKS	One crack, ¼ inch long
Liner Cap for:	
MISSING RIVETS	Not serviceable
CRACKS	2 cracks, ⅛ inch long
DENTS, BUCKLES AND DISTORTION	⅛ inch from original contour as long as part can be assembled
BURN HOLES	Not serviceable
Rear Liner for:	
CRACKS	2 cracks, ½ inch long
DENTS, BUCKLES AND DISTORTION	⅛ inch from original contour
CRACKS IN SNOUT	One crack, ⅜ inch long
BUCKLES, DENTS AND DISTORTION IN SNOUT EXCEPT TRAILING EDGE	½ inch from original contour

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4C-2-8-(65-1)A

Figure 12-13. Torch Igniter Limits (Sheet 1 of 2)

INSPECT	MAX. SERVICEABLE LIMITS
SNOUT TRAILING EDGE BURNING	One inch max. depth, ¾ sq. inch of missing material
SNOUT TRAILING EDGE DISTORTION	⅜ inch from original contour
TAB TO SNOUT WELD CRACKS	2 cracks 1/4 inch long
Fuel Nozzle for:	
PARENT METAL CRACKS	Not serviceable
TUBE TO TUBE WELD CRACKS	One crack, ¼ inch long provided there is no leakage
SLEEVE TO TUBE WELD CRACK	One crack, ⅛ inch long
TUBE TO CASTING WELD CRACK	Not serviceable
FUEL AND AIR ORIFICE FOR CLOGGING	Not serviceable

INSPECT	MAX. SERVICEABLE LIMITS
TUBE SLEEVE WEAR	0.585 inch diameter after high metal removal
TUBE BODY BENDS	Any amount if assembly or operation are not impaired

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4C-2-8-(65-2)A

Figure 12-13. Torch Igniter Limits (Sheet 2 of 2)

INSPECT	MAX. SERVICEABLE LIMITS
TURBINE FRAME STRUT FAIRINGS FOR LOOSE OR MISSING RIVETS	NOTE The 2 rivets at the fairing outer end to turbine frame location must be installed. 2 rivets at fairing inner end and 2 rivets at fairing trailing edge may be loose or missing.

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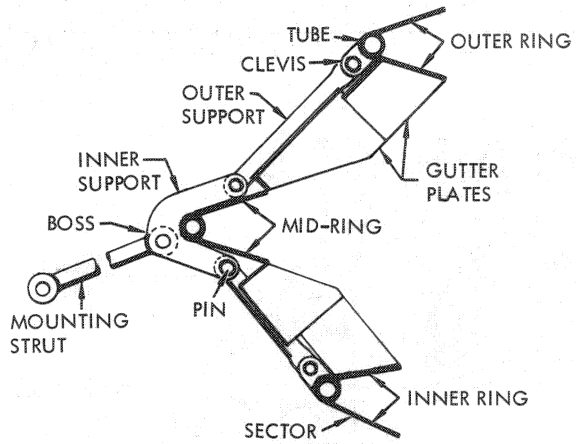
Figure 12—13A. Turbine Frame Strut Limits



INSPECT	MAX. SERVICEABLE LIMITS
FLAMEHOLDER	
NOTE: Inspect part with 3x glass. Accept one crack per weld or 10 inches of weld, whichever is less provided the crack does not exceed ⅛ inch or extend into parent metal unless otherwise specified. Disregard cracks up to 1/16 inch long.	
All Areas of Mounting Struts for:	
PARENT METAL CRACKS	One per strut ¼ inch long
BURNED AREAS	Not serviceable
Struts to Boss Welds for:	
CRACKS	One per strut ¼ inch long
All Areas of Outer Supports for:	
PARENT METAL CRACKS	7 per strut, ⅜ inch long behind plates
BURNED AREAS	Any number 0.020 inch deep
Support to Boss Weld for:	
CRACKS	One per support ¼ inch long
All Areas of Inner Support and Clevis for:	
PARENT METAL CRACKS	Not serviceable
BURNED AREAS	Any number 0.020 inch deep
Outer Support and Clevis to Tube Welds for:	
CRACKS	2 per weld, ¼ inch long

INSPECT	MAX. SERVICEABLE LIMITS
All Areas of Rings for:	
PARENT METAL CRACKS	Cracks extending into front side of tube are not serviceable. Any number of rear side cracks or missing pieces are acceptable.
MISSING MATERIAL	¾ inch long by ½ inch wide per sector (between supports) per ring; not to exceed 2 square inches of missing material per ring
EROSION	0.030 inch deep, tapering to a knife edge at aft edge
DISTORTION	Any amount provided the flameholder can be assembled
Ring to Tube Welds for:	
CRACKS	5 per weld, ¾ inch long, minimum separation 2 inches
All Areas of Tubes for:	
PARENT METAL CRACKS	Any number (aft side only); Cracks extending into front side of tube are not serviceable
BURNED AREAS	0.030 inch deep
All Areas of Gutter Plates for:	
PARENT METAL CRACKS	Any number ¾ inch
EROSION AND MISSING METAL	25 percent of plate area missing. Erosion 1/32 inch deep tapering to knife edge at aft end
PLATE TO RING WELD CRACKS	Any number totaling one inch per plate
PLATE TO SUPPORT WELD CRACKS	Any number totaling one inch per plate

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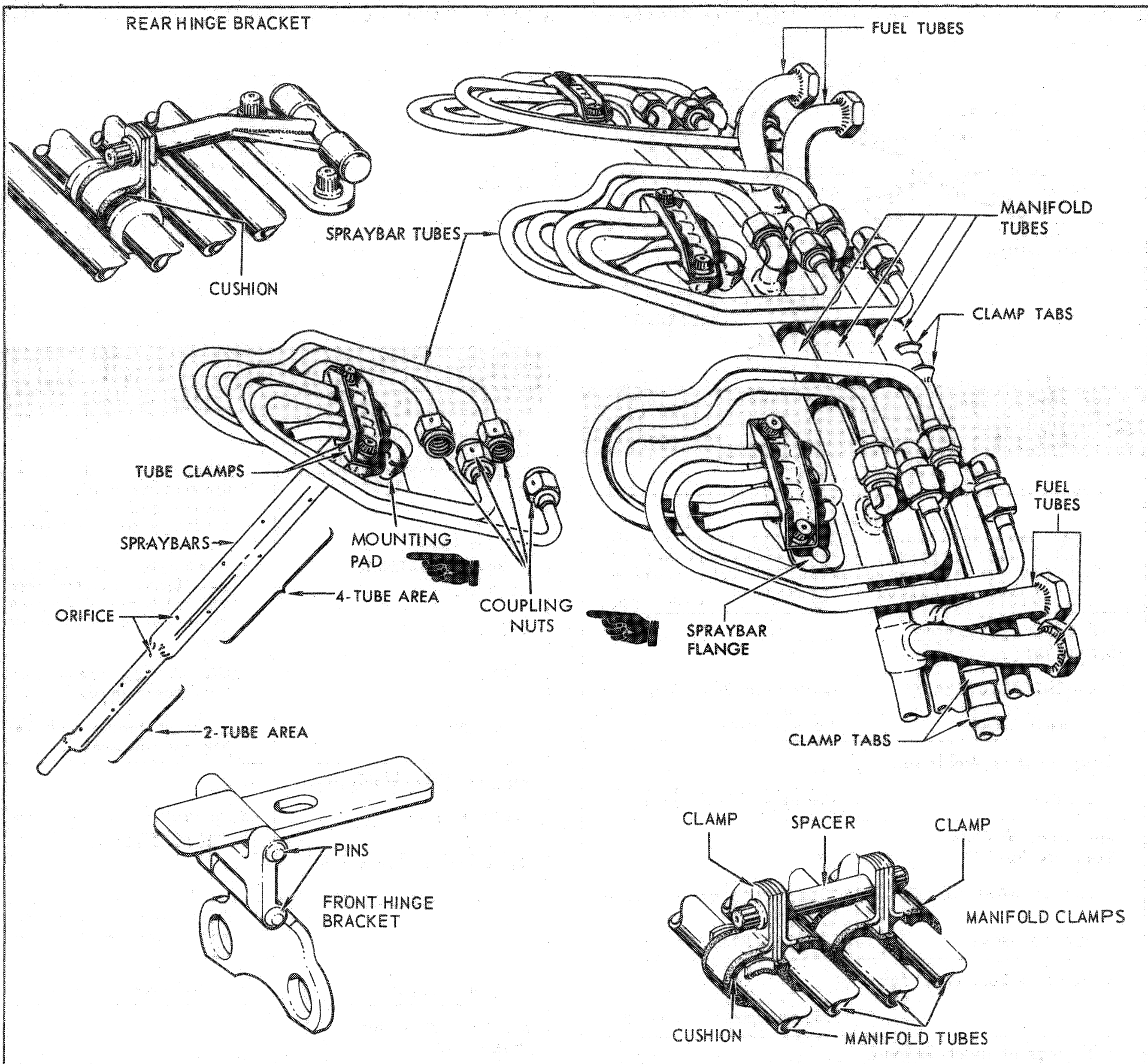
Figure 12-14. Flameholder Limits



INSPECT	MAX. SERVICEABLE LIMITS
AFTERBURNER MANIFOLD AND SPRAYBARS	
Front Hinge Bracket for:	
CRACKS	Not serviceable
Pins for:	
CRACKS	Not serviceable
WEAR	Not serviceable

INSPECT	MAX. SERVICEABLE LIMITS
Manifold Tubes for:	
CRACKS (INCLUDING WELDS)	Not serviceable
NICKS, SCRATCHES AND GOUGES	0.005 inch deep. Not serviceable if on flared end
CHAFING (WEAR)	0.010 inch deep, maximum

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4C-2-8-(67-1)A

Figure 12-15. Afterburner Manifold and Spraybar Limits (Sheet 1 of 2)

INSPECT	MAX. SERVICEABLE LIMITS
Manifold Clamps for:	
CRACKS	Not serviceable
Manifold Clamp Tabs for:	
CRACKS	Any number not extending into manifold
Cushions for:	
WEAR	Any amount provided clamp does not contact manifold
Rear Hinge Brackets for:	
CRACKS	Not serviceable
Spraybar Tubes for:	
CRACKS	Not serviceable
WEAR (CHAFFING)	0.005 inch max depth at worn area
NICKS, SCRATCHES AND GOUGES	Any number 0.003 inch deep
DISTORTION (DENTS)	1/32 inch deep, provided there is a 1/8 inch radius
Coupling Nuts for:	
CRACKS	Not serviceable
Tube Clamps for:	
CRACKS	Any number of indications allowed at spot welds; no cracks allowed in other areas

INSPECT	MAX. SERVICEABLE LIMITS
Cushions for:	
LOOSENESS OR WEAR	Any amount, provided enough cushion remains to contact tubes and holds tight with a 35 pound pull in either forward or rear axial direction
Spraybar Mounting Pad for:	
PARENT METAL CRACKS	2, 1/8 inch long
Mounting Pad to Support Welds for:	
CRACKS	2, 1/8 inch long
Mounting Pad to Tube Braze for:	
CRACKS OR MISSING BRAZE	Any amount
Spraybars for:	
CRACKS (OTHER THAN AT ORIFICES)	Not serviceable
DISTORTION (BENDING)	1/4 inch from original shape
NICKS, SCRATCHES AND GOUGES	0.005 inch deep, after removal of high metal
Orifices for:	
CRACKS (4 TUBE AREA)	Any 4 orifices, cracks 3/32 inch long, provided they do not extend on both sides of any one orifice. Cracks may be inter-connected between opposing orifices in same tube
CRACKS (2 TUBE AREA)	Not serviceable
TUBE TO TUBE WELD CRACKS	Not serviceable

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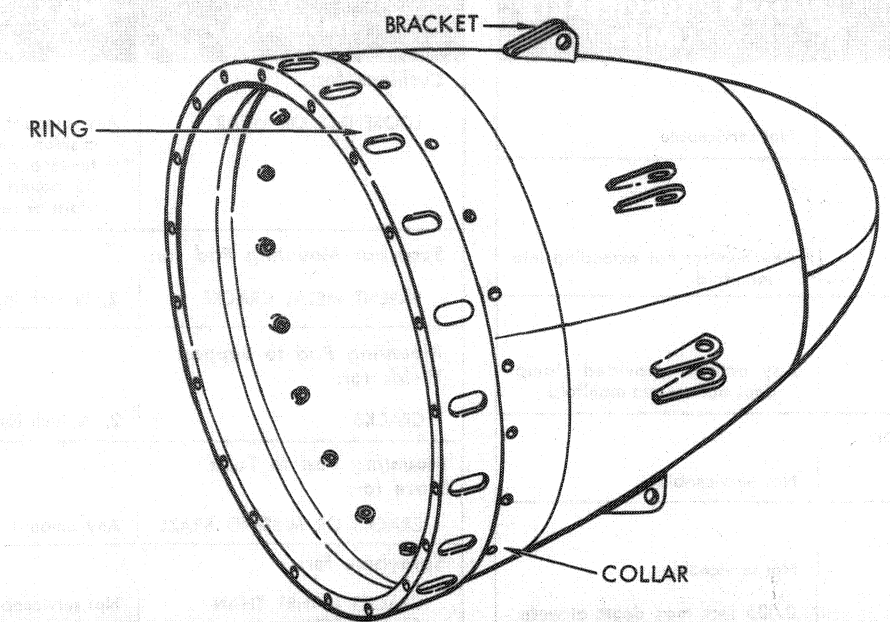
Figure 12-15. Afterburner Manifold and Spraybar Limits (Sheet 2 of 2)



INSPECT	MAX. SERVICEABLE LIMITS
INNER REAR CONE	
Ring for:	
CRACKS	6 per ring, 1/4 inch long, provided there are no cracks in the aft radius of the bolt access hole
Bracket for:	
CRACKS	2 per lug, 1/8 inch long and not within 1/4 inch of hole
BURNED AREAS	Not serviceable
BRACKET TO CONE WELD CRACKS	
Longitudinal	3 per weld, 1/4 inch long

INSPECT	MAX. SERVICEABLE LIMITS
Cone Body for:	
PARENT METAL CRACKS	3 per cone not exceeding 1/4 inch long
BUTT WELD CRACKS	
Longitudinal	5 per weld 1/4 inch long
PARENT METAL BURNING AND EROSION	Mild oxidation over entire body not exceeding 10 percent of original metal thickness
DENTS, BUCKLES, BULGES, ETC.	Total of 3 not to exceed 1/4 inch in depth or height, provided radius of buckle or bulge is not less than 4 times depth or height. Buckles or bulges must have min separation of 3 inches.

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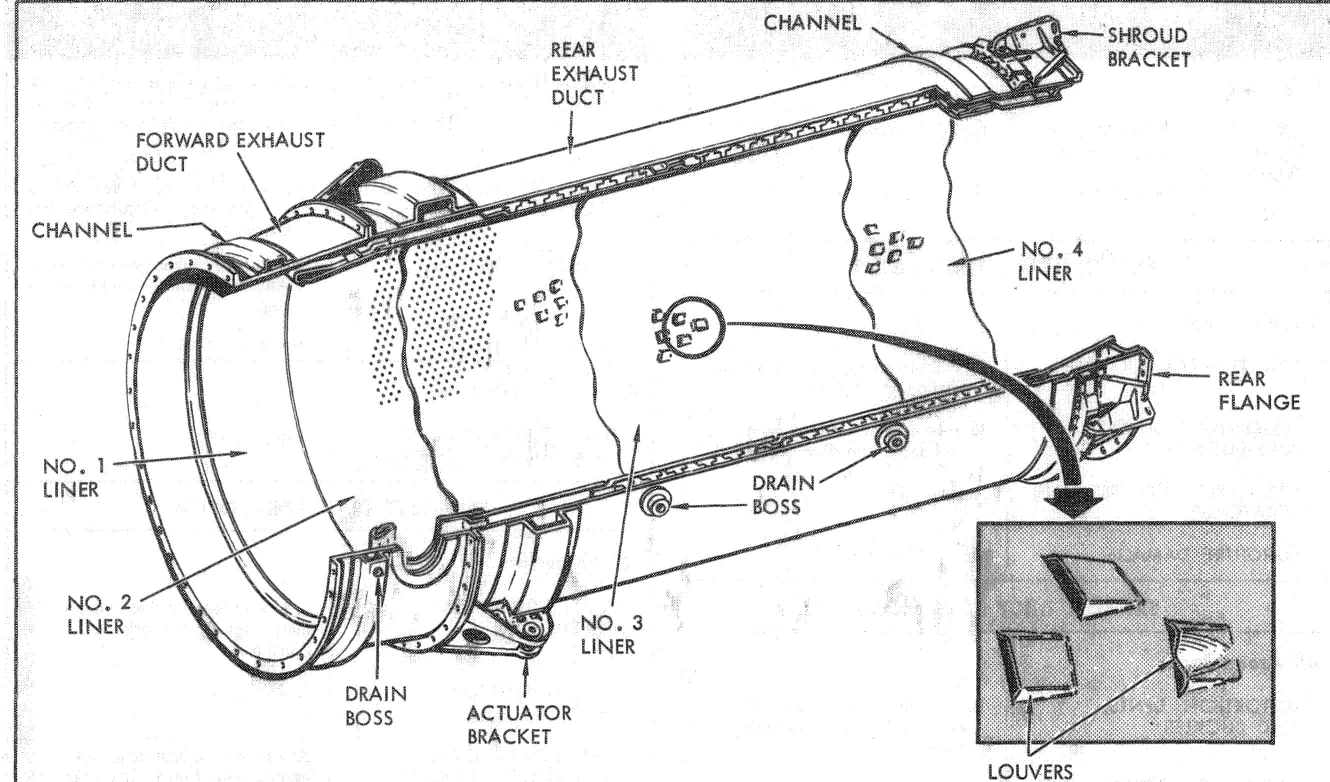
Figure 12-16. Inner Rear Cone Limits



INSPECT	MAX. SERVICEABLE LIMITS
FORWARD EXHAUST DUCT	
All Areas for:	
PARENT METAL CRACKS	Any number ¼ inch maximum; minimum separation one inch
DENTS, BUCKLES, BULGES	¼ inch deep, 3 inches in diameter; minimum separation 6 inches
NICKS, PITS, SCRATCHES, GOUGES	Any amount
PUNCTURE DAMAGE	Not serviceable
Channel for:	
PARENT METAL CRACKS	Two, ½ inch long
Drain Boss for:	
WELD CRACKS	Two, ⅛ inch long
Torch Igniter Pad for:	
PARENT METAL CRACKS	Any number provided no pieces will fall out or are missing

INSPECT	MAX. SERVICEABLE LIMITS
REAR EXHAUST DUCT	
All Areas for:	
PARENT METAL CRACKS	Any number ¼ inch long; minimum separation one inch
DENTS, BUCKLES, AND BULGES	5/16 inch deep, 3 inches in diameter; minimum spacing 6 inches
NICKS, PITS, GOUGES, AND SCRATCHES	Any amount
PUNCTURE DAMAGE	Not serviceable
Actuator Brackets for:	
PARENT METAL CRACKS	Two, ¼ inch long
BOSS CRACKS	Two, ¼ inch long
FORWARD FLANGE WELD CRACKS	One per weld, one inch long including parent metal extension
Drain Bosses for:	
WELD OR PARENT METAL CRACKS	Two, 1 1/2 inches long

4C-2-8-(69-1)C

Figure 12-17. Exhaust Duct Limits (Sheet 1 of 2)

INSPECT	MAX SERVICEABLE LIMITS
Channels for:	
CRACKS IN SEAM WELD ADJACENT TO ACTUATOR BRACKET	Not serviceable
EXHAUST DUCT LINER NO. 1	
All Areas for:	
PARENT METAL CRACKS	One, 2 inches long or an accumulation to 4 inches
DISTORTION, DENTS, AND BUCKLES	¼ inch out of contour with one inch minimum diameter
NICKS, PITS, GOUGES, AND SCRATCHES	Any amount
PUNCTURE DAMAGE	Not serviceable
EXHAUST DUCT LINER NO. 2	
All Areas for:	
DISTORTION, DENTS, AND BUCKLES	¼ inch deep; 4 inches in diameter, minimum separation 6 inches
NICKS, PITS, GOUGES AND SCRATCHES	Any amount
CIRCUMFERENTIAL CRACKS BETWEEN LOUVERS	10 per circumferential row ¼ inch long; 2 cracks up to ½ inch long, minimum spacing of 3 louvers
AXIAL CRACKS BETWEEN LOUVERS	One per liner, not closer than 5 louvers from a circumferential crack
CRACKS BETWEEN ACCOUSTICAL HOLES	4 connective cracks, provided each series of cracks is separated by 4 uncracked holes
CLOSED LOUVERS	One per axial row; all others 0.030 inch gap
PUNCTURE DAMAGE	Not serviceable
Ceramic Coating for:	
DISCOLORATION, DETERIORATION AND CHIPPING	Any amount
EXHAUST DUCT LINER NO. 3	
All Areas for:	
DISTORTION, DENTS, AND BUCKLES	¼ inch deep; 3 inches in diameter, minimum separation 6 inches
NICKS, PITS, GOUGES AND SCRATCHES	Any amount
CIRCUMFERENTIAL CRACKS BETWEEN LOUVERS	10 per circumferential row ¼ inch long; 2 cracks up to ½ inch long, minimum separation of 3 louvers
AXIAL CRACKS BETWEEN LOUVERS	One per liner, not closer than 5 louvers from a circumferential crack
CLOSED LOUVERS	One closed louver per axial row. All others 0.030 inch minimum gap
COMBAT DAMAGE	Not serviceable
Ceramic Coating for:	
DISCOLORATION, DETERIORATION AND CHIPPING	Any amount
EXHAUST DUCT LINER NO. 4	
All Areas for:	
DISTORTION, DENTS AND BUCKLES	3/8 inch deep; 3 inches in diameter; minimum separation of 6 inches.
NICKS, PITS, GOUGES AND SCRATCHES	Any amount
PARENT METAL CRACKS NOT EMANATING FROM LOUVERS	Any number ½ inch long, minimum spacing 1 inch. 10 cracks 1¼ inch long, minimum spacing 1 inch
CRACKS EMANATING FROM LOUVERS	2 per louver ½ inch long, provided no adjacent louvers are connected by cracks. 10 cracks up to 3/4 inch long, minimum spacing of 1 louver.
CLOSED LOUVERS	One closed louver per axial row; all others 0.030 inch minimum gap.
PUNCTURE DAMAGE	Not serviceable
EROSION	Any amount at rear or forward edges, provided at least 3/16 inch engagement with mating part exists.
AXIAL CRACKS FROM AFT ROW OF LOUVERS TO TRAILING EDGE	One per convolution
MISSING PIECES OR BURNED OUT AREAS	Not serviceable
Ceramic Coating for:	
DISCOLORATION, DETERIORATION AND CHIPPING	Any amount

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Figure 12-17. Exhaust Duct Limits (Sheet 2 of 2)

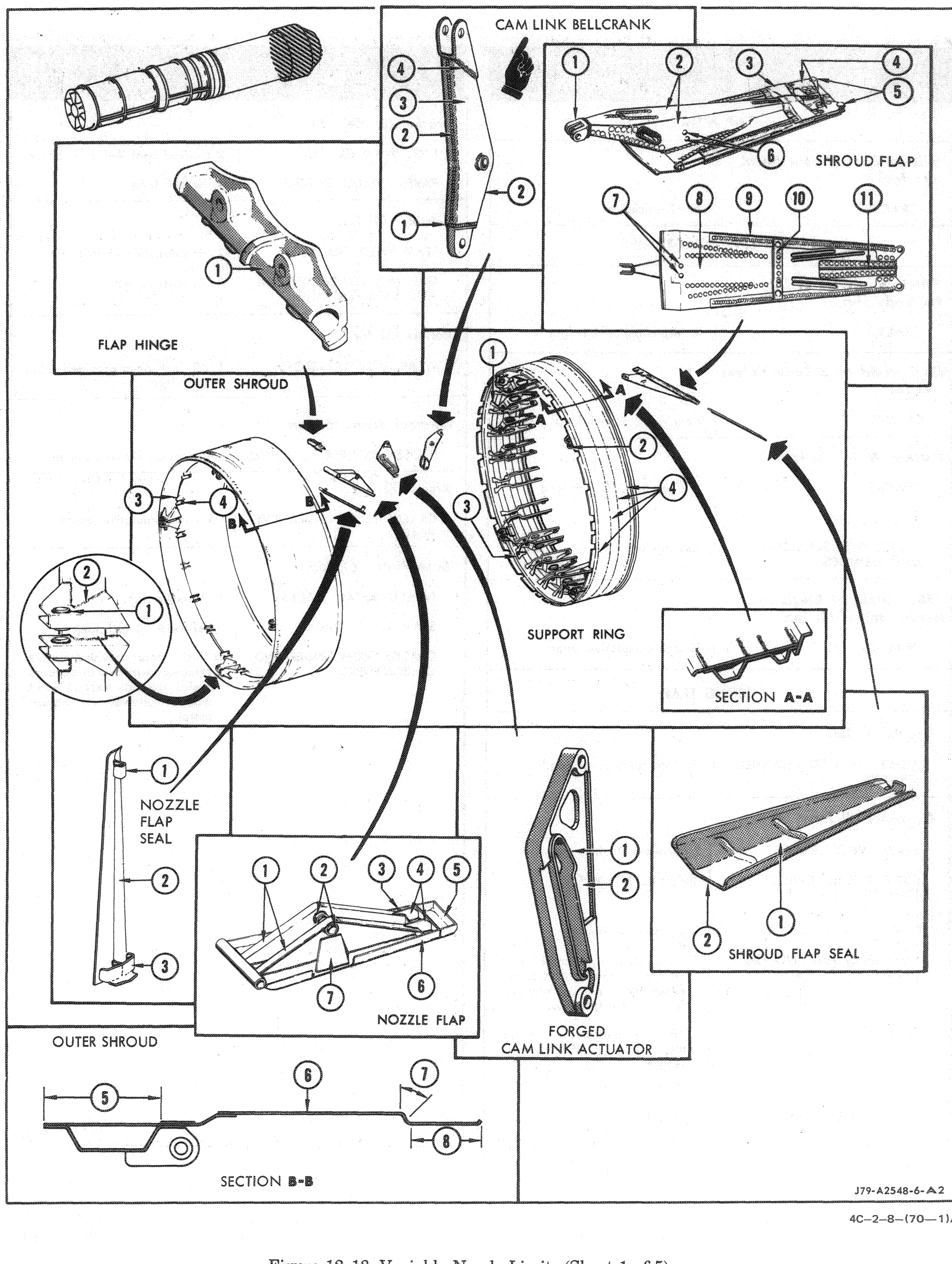

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Figure 12-18. Variable Nozzle Limits (Sheet 1 of 5)

INSPECT	MAX SERVICEABLE LIMITS
FLAP HINGE	
Hinge Body Parent Metal (1) for:	
CRACKS	Not Serviceable
CAM LINK BELLCRANK	
Fillet Welds (1) at Lug to Body for:	
CRACKS	⅜ inch cumulative length
Butt Weld of 2 Body Halves (2) for:	
CRACKS	2 per weld, ¼ inch long
Parent Metal (3) for:	
CRACKS	Two per flap, ⅛ inch long
NICKS, PITS, SCRATCHES, AND GOUGES	Any amount
Fillet Weld at Clevis to Body Halves (4) for:	
CRACKS	⅜ inch cumulative length
SHROUD FLAP	
Clevis (1) for:	
FILLET WELD TO CHANNEL CRACKS	¼ inch cumulative length
Channel (2) for:	
SEAM WELD CRACKS	2 per weld, ½ inch long
FUSION WELD CRACKS, TRAILING EDGE	One per weld, 1 inch long.
PARENT METAL CRACKS	Four, ¾ inch long
CRACKS EMANATING FROM UNDER RIVET HEAD	⅜ inch long, rivet cracks and parent metal cracks must not exceed total number allowed for parent metal
DISTORTION	3/16 deep and not extending more than ½ the channel length

INSPECT	MAX SERVICEABLE LIMITS
Bracket (3) for:	
SPOT WELD CRACKS	2 cracked spot welds per bracket
PARENT METAL CRACKS	4, ¼ inch long
Retainer (4) for:	
SEAM WELD CRACKS	2 per weld, ¼ inch long
GAP BETWEEN RETAINER (4) AND BASE PLATE (8)	1/16 to 3/32 inch
Rollers (5) for:	
WEAR AND FLAT SPOTS	1/32 inch deep provided roller turns free
Channel Rivets (6) for:	
LOOSENESS (FREE TO MOVE)	One rivet per side of channel
Rivets (7) for:	
CRACKS FROM UNDER RIVET HEAD	¾ inch cumulative length
Base Plate (8) for:	
PARENT METAL CRACKS	4, ¾ inch long
SEAM WELD CRACKS	2 per weld, ¼ inch long
CRACKS FROM UNDER END OF STIFFENERS	¾ inch long; provided cracks combined with rivet and parent metal do not exceed total number allowed for parent metal

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4C-2-8-(70-2)B

Figure 12-18. Variable Nozzle Limits (Sheet 2 of 5)

INSPECT	MAX. SERVICEABLE LIMITS
Stiffeners (9) for:	
SEAM WELD CRACKS	2 per weld, ¼ inch long
Brace (10) for:	
DISTORTION	Any amount provided gap between retainer (4) and base plate (8) is maintained
LOOSE RIVETS	Not serviceable
Angle Support (11) for:	
FILLET WELD CRACKS	1 per weld, ⅛ inch long
SPOT WELD CRACKS	6 cracked spot welds per row
PARENT METAL CRACKS	2 per support, ¼ inch long
NOZZLE FLAP SEAL	
Bracket (1) for:	
PARENT METAL CRACKS	One, 3/16 inch long
Body (2) for:	
CRACKS	3, 3/16 inch long with ¼ inch minimum spacing. Any number 1/16 inch long
BENDING OR DISTORTION	1/16 inch from original contour
NICKS, SCRATCHES, GOUGES AND PITS	1/64 inch deep
Retainer (3) for:	
RETAINER TO SUPPORT FILLET WELD CRACKS	One, 3/16 inch long or a cumulative total of ¼ inch
NOZZLE FLAP	
Ribs (1) for:	
RIB TO BODY FILLET WELD CRACKS	1 per weld ¼ inch long or a cumulative total of 5/16 inch long

INSPECT	MAX. SERVICEABLE LIMITS
Bushings (2) for:	
BUSHING TO RIB FILLET WELD CRACKS	1 per weld ⅛ inch long
Guide (3) for:	
FILLET WELD CRACKS	1 per weld ¼ inch long
Gussets (4) for:	
FILLET WELD CRACKS	1 per weld ⅛ inch long
Extension (5) for:	
FILLET WELD CRACKS	1 per weld ⅛ inch long or a cumulative total of ⅜ inch long
Body (6) for:	
CRACKS	2, ⅛ inch long
BUCKLES AND BULGES	1/16 inch from original surface
NICKS, SCRATCHES, AND GOUGES	1/32 inch deep
CRACKS IN CENTER PORTION OF FLAP	Any number of cracks 1/2 inch long. Any number of cracks 1/2 inch to 1 1/2 inches long with a minimum spacing of 1/2 inch.
Stiffeners (7) for:	
FILLET WELD CRACKS	1 per weld ¼ inch long
FORGED ACTUATOR CAM LINK	
Track (1):	0.010 inch change from true shape
Body (2):	
HOLE WEAR (ELONGATION)	0.263 inch max diameter
NICKS, PITS, SCRATCHES, AND GOUGES	0.015 inch deep

4C-2-8-(70-3)D

Figure 12-18. Variable Nozzle Limits (Sheet 3 of 5)

INSPECT	MAX SERVICEABLE LIMITS
SHROUD FLAP SEAL	
Seal Body (1) for:	
WEARING OR RUBBING	Up to 1/32 inch depth, any length or width
CRACKS	4 cracks, ⅛ inch long or a total accumulation to ½ inch
BUCKLES AND DENTS (ALL AREAS)	1/16 inch depth on surface
DISTORTION	1/16 inch from original contour
NICKS, PITS, SCRATCHES AND GOUGES	To 1/32 inch deep
Trailing Edge (2) for:	
WEAR	⅛ inch deep
OUTER SHROUD	
Shroud Support Bracket (1):	
PARENT METAL CRACKS	1 per bracket-half; ¼ inch long
Support Bracket to Channel Fillet Welds (2):	
CRACKS	1 per weld; per pair of brackets ¼ inch long
Cam Link Support Bracket (3):	
PARENT METAL CRACKS	Not serviceable
Bracket to Channel Welds (4):	1 per weld per pair of brackets; ¼ inch long
Gusset to Channel Welds:	
CRACKS	1 per weld per pair of brackets ¼ inch long
Gusset Parent Metal:	
CRACKS	Not serviceable
Bracket Boss Hole ID Elongation:	0.256 maximum dimension

INSPECT	MAX SERVICEABLE LIMITS
Front Cylinder (5):	
All Areas:	
PARENT METAL CRACKS	Not serviceable
NICKS	Any number 1/64 inch deep
DENTS	Any number ⅜ inch deep
DISTORTION	⅜ inch from original contour
Seam Welds to Channel:	
CRACKS	8, ½ inch long; minimum separation 4 inches
Wear on OD:	Any number of areas in wear band 0.015 inch deep (average) provided none exceeds 0.025 inch deep
Channel:	
PARENT METAL CRACKS	Not serviceable
Rear Cylinder (6):	
All Areas:	
PARENT METAL CRACKS	4, ¼ inch long
NICKS	Any number 1/64 inch deep
DENTS	Any number ⅜ inch deep
Aft Radius of Hat Section (7):	
WEAR	Any length, 0.015 inches deep
All Lip Area (8):	
WEAR	2 areas, 10 inches maximum length, any width, completely through parent metal after removal of rough edges that would restrict the movement of the support ring
Puncture Damage:	Not serviceable
SUPPORT RING	
Flap Support Brackets (1) for:	
BOSS TO BRACKET FILLET WELD CRACKS	1 per weld, ⅛ inch long

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4C-2-8-(70-4)

Figure 12-18. Variable Nozzle Limits (Sheet 4 of 5)

INSPECT	MAX. SERVICEABLE LIMITS
BRACKET TO FORWARD CHANNEL FILLET WELD CRACKS	2 per weld 3/16 inch long or a cumulative total of ⅜ inch long
BRACKET TO REAR CHANNEL FILLET WELD CRACKS	2 per weld ⅜ inch long or a cumulative total of ¾ inch long
PARENT METAL CRACKS	1 per bracket ¼ inch long
Nozzle Actuator Brackets (2) for:	
PARENT METAL CRACKS	1 per side of a bracket, 3/16 inch; not more than 4 per ring
BOSS TO BRACKET FILLET WELD CRACKS	1 per weld ⅛ inch long
BRACKET TO CHANNEL WELDS	⅜ inch cumulative length
Cable Bracket (3) for:	
FILLET WELD CRACKS	1 per weld, ⅛ inch long or a cumulative total of 3/16 inch long

INSPECT	MAX. SERVICEABLE LIMITS
Seam Welds (4) for:	
CRACKS	3 per weld, ¼ inch long
Spot Weld for:	
CRACKS	6 spot welds provided adjacent spot welds are not cracked
Parent Metal Outer Cylinder for:	
CRACKS	Any number, ½ inch cumulative length
PUNCTURE DAMAGE	Not serviceable
NICKS, PITS, SCRATCHES AND GOUGES	1/64 inch deep
WEAR (EXCEPT AFT LIP)	1/64 inch deep
DISTORTION (BUCKLES AND WAVINESS)	Circumference of working surface not in excess of 118.5 inches

J79-A2552-8-D2

4C-2-8-(70-5)A

Figure 12-18. Variable Nozzle Limits (Sheet 5 of 5)

SECTION XIII

ENGINE INSTALLATION

DESCRIPTION AND OPERATION

13-1. DESCRIPTION.

13-2. Sections III thru XII of this manual provide description, operation, and maintenance information for the basic J79-15/15A engine, the engine systems and the system components. Information contained in this section covers the engine as an assembled integral unit. The information also includes those related components and/or assemblies which are not included in the system breakdown of this manual.

13-3. **ACCESS DOORS.** Doors and removable panels provide access for maintenance, engine removal and installation, component removal, and servicing of the engine and engine accessories. See figure 13-1.

13-4. **ENGINE COMPONENTS.** Figure 13-2 provides a means of locating a particular component on the engine. Maintenance information for engine accessories and individual components of power plant associated systems is provided in the coverage for that particular system.

13-5. **ENGINE COMPONENT ACCESS.** The following paragraphs are intended as a guide to aid in locating engine components, in terms of their relative location above, on, or below the horizontal centerline or bottom center portion of the engine.

13-6. **Above Horizontal Centerline:**

a. Oil System:

(1) Nozzle Actuator (left side; access door 96L or R).

(2) Air-Oil Cooler Fittings (left side; access doors 81R, 82L).

(3) Oil Tank (right side; access doors 81L, 82R).

(4) Air Pressure and Vacuum Relief Valve (right side).

(5) Nozzle Actuator (right side; access door 96L/R).

b. Engine Bleed System:

(1) 17TH Stage Bleed Air Manifold (left side; access doors 83L/R).

(2) Anti-Icing Air Manifold (left side).

(3) Anti-Icing Valve (right side).

(4) 17TH Stage Bleed Air Manifold (right side; access doors 83L/R).

(5) Anti-Icing Air Manifold (right side).

c. Fuel System:

(1) Variable Vane Actuator (left side).

(2) Fuel Nozzles (left side).

(3) Variable Vane Actuator (right side; access doors 81L or 82R).

(4) Fuel Nozzles (right side).

13-7 **On or Below Horizontal Centerline:**

a. Oil System:

(1) Nozzle Actuator (left side; access doors 96L/R).

(2) Scavenge Oil Filter (left side; access doors 81L, 82R).

(3) Afterburner Oil Cooler (left side; access doors 83L/R, 81L, 82R).

(4) Main Oil Cooler (right side; access doors 83L/R).

(5) Nozzle Actuator (right side; access doors 96L/R).

b. Fuel System:

(1) Fuel Nozzles (left side; access doors 83L/R).

(2) Afterburner Fuel Pumps (left side; access doors 81R, 82L, 74).

(3) Afterburner Ignition Switch (left side; access doors 81R, 82L).

(4) Afterburner Fuel Control (left side; access doors 81, 82L/R, 83L/R).

(5) Fuel Bypass Valve (left side; access doors 81L, 82R).

(6) Afterburner Fuel Filter (left side; access doors 81R, 82L).

(7) CIT Sensor Coil (left side; access doors 73, 74, 81L/R, and 82L/R).

(8) Inlet Fuel Manifold (left side; access doors 81, 82L/R).

(9) Variable Vane Actuator (right side; access door 82R).

(10) Pressurizing and Drain Valve (right side; access doors 83L/R).

(11) Main Fuel Pump and Low Pressure Fuel Filter (right side; access doors 78L, 81L, 82R).

(12) Fuel Nozzles (right side; access doors 83L/R).

c. Electrical System:

(1) Control Alternator (left side; access doors 81, 82L/R).

(2) Afterburner Ignition Switch (left side; access doors 81R, 82L).

(3) Temperature Amplifier (left side; access doors 81R, 82L).

(4) Oil Pressure Transmitter (left side; access doors 83L/R).

(5) Anti-Icing Indicator Switch (left side).

(6) Nozzle Area Control (left side; access doors 83L/R).

(7) Fuel Flow Transmitter (right side; access doors 81L, 82R).

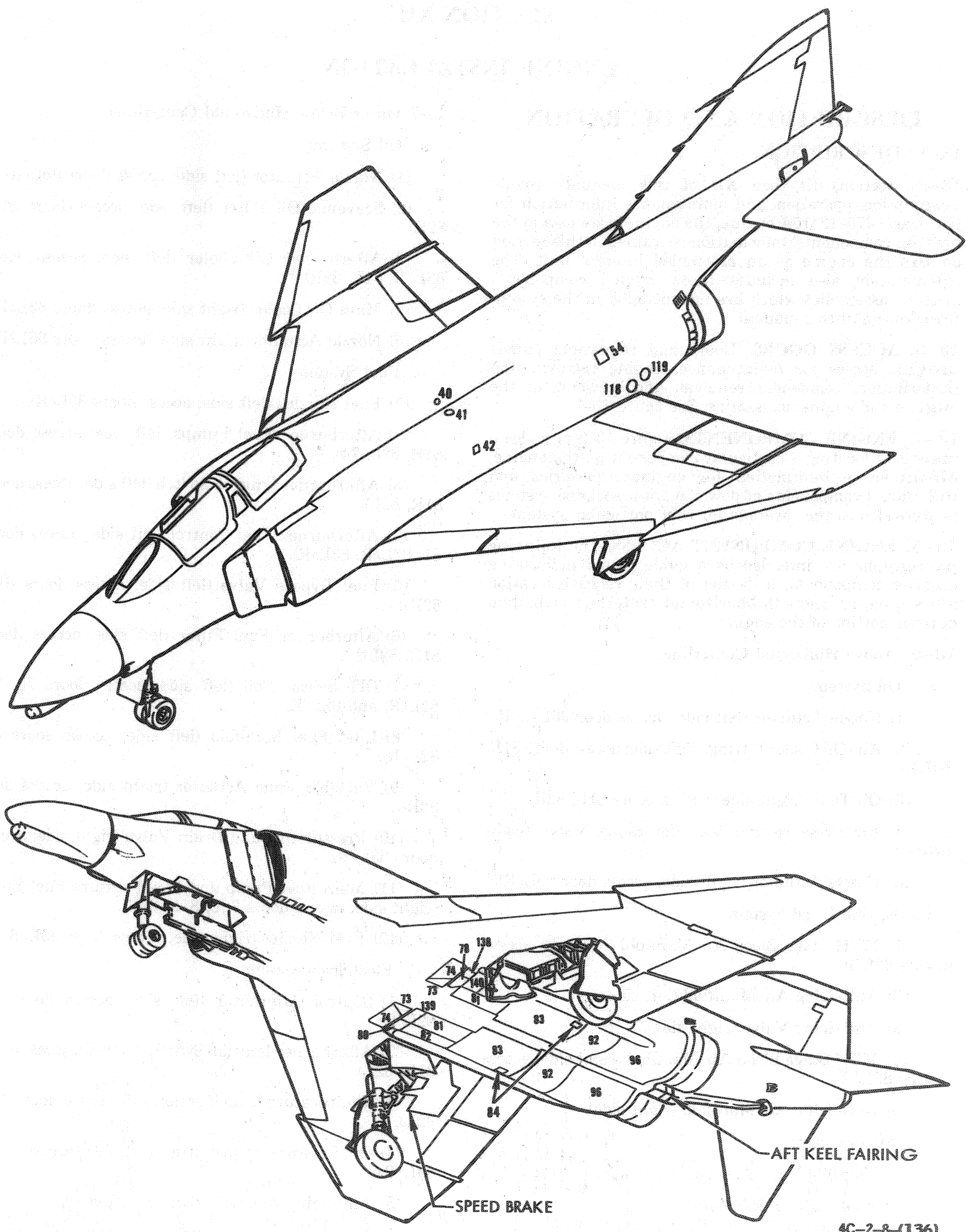

Figure 13-1. Access Doors

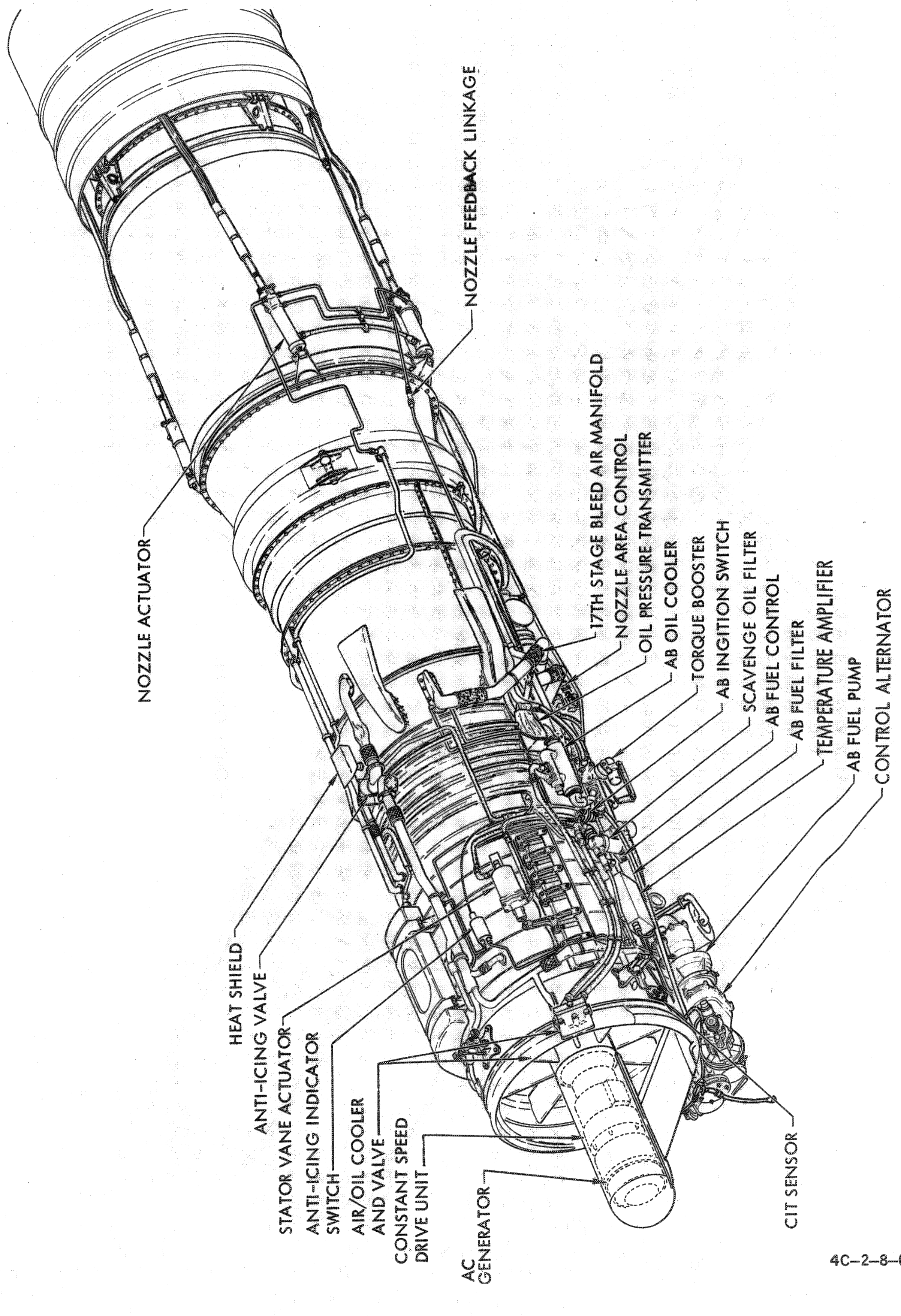

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Figure 13-2. Engine Components (Sheet 1 of 2)

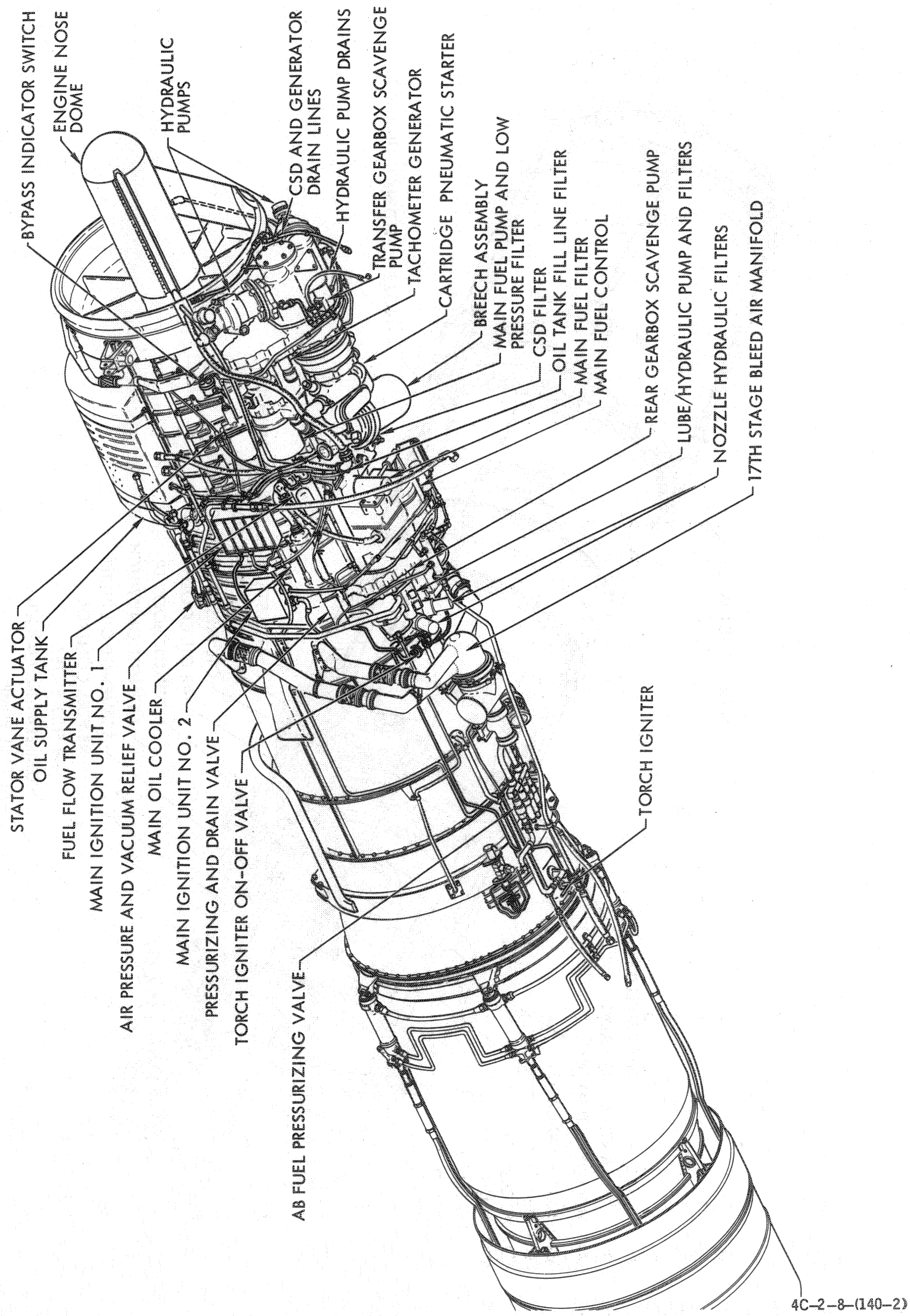


Figure 13-2. Engine Components (Sheet 2 of 2)

(8) Bypass Indicator Switch (right side; access doors 81, 82L/R).

(9) Main Ignition Unit No. 1 (right side; access doors 83L/R).

(10) Main Ignition Unit No. 2 (right side; access doors 83L/R).

(11) Main Igniter, No. 4 Combustion Chamber (right side; access doors 83L/R).

(12) Main Igniter, No. 5 Combustion Chamber (right side; access door 83L/R).

d. Engine Drain System:

NOTE

All engine drain system components are located on the left side of the engine.

(1) Constant Speed Drive (access doors 74L/R).

(2) Hydraulic Pump (access doors 73, 74L/R).

(3) Sump Vent (access doors 73, 74L/R).

e. Airframe Hydraulic System:

(1) Hydraulic Pump (left side; access doors 73, 74L/R).

(2) Hydraulic Pump (right side; access doors 73, 74L/R).

f. Engine Bleed System:

(1) Compressor Leakage Air Duct (left side; access doors 83L/R).

(2) Compressor Leakage Air Duct (right side; access doors 83L/R).

13-8 **Bottom Center.**

a. Engine Drain System:

NOTE

All engine drain system components are located on the left side of the engine.

(1) Accessory Drain Tube (access doors 92L/R).

(2) Accessory Drain Hose (access doors 92L/R).

(3) Combustion Chamber Drain Tube (access doors 92L/R).

(4) Combustion Chamber Drain Line (access doors 92L/R).

(5) Turbine Frame Drain (access doors 92L/R).

(6) Main Fuel Control Drain (access doors 82L/R).

b. Fuel System:

(1) Torch Igniter (left side; access doors 92L/R).

(2) Afterburner Fuel Pressurizing Valve (left side; access doors 83L/R).

(3) Main Fuel Control (left side; access doors 81, 82, and 83L/R).

(4) Torque Booster (left side; access doors 81L, 82R).

(5) Main Fuel Filter (left side; access doors 81, 82L/R).

c. Cartridge/Pneumatic Starting System:

(1) Cartridge/Pneumatic Starter (left side; access doors 81L/R, 82L/R, 140)

(2) Cartridge Breech Assembly (left side; access doors 140, 81R).

(3) Starter Exhaust Duct (left side; access doors 80, 78).

(4) Starter Pneumatic Inlet Duct (left side; access doors 138, 139, 81L and 82R)

d. Oil System:

(1) Oil Servicing Bracket (right side; access doors 81, 82L/R).

(2) CSD Scavenge Filter (right side; access doors 81, 82L/R).

(3) Lube and Hydraulic Pump and Filter (right side; access doors 83L/R).

(4) Transfer Gearbox Scavenge Pump (right side; access doors 74L/R)

(5) Rear Gearbox Scavenge Pump (right side; access doors 83L/R).

(6) Intermediate Bearing Housing (right side; access doors 81, 82L/R).

(7) Nozzle Pump (right side; access doors 83L/R).

(8) Nozzle Hydraulic Filters (right side; access doors 83L/R).

e. Electrical System;

(1) Afterburner Spark Plug (right side; access doors 92L/R).

(2) Tachometer Generator (right side; access doors 78 and 80)

13-9. **ENGINE DRAINS.** See figure 13-3.

13-10. **Forward Drain Lines.** Two forward lines are at the lower center of the engine at FS 318. One line provides a drain for the transfer gear box shaft seals, main and afterburner pump, control alternator, and the hydraulic pumps. The other drain line provided, drains the engine nose dome, CSD, and generator. Access to the forward drain lines is through doors 73L or R and 74L or R.

13-11. **Sump Pressurization Valve Vent Line.** The oil system vent is a 1 inch line from the sump pressurizing valve to the overboard vent connection. Overboard connections are located at FS 321.45 and BL 9.45 on left engine installations and at FS 320.46 and BL 39.33 on right engine installations. Access to the vent line is through doors 74L or R.

13-12. **Main Fuel Control Seal Drain.** The main fuel control seal drain line provides a drain for the main fuel control carbon seal. The drain line is vented overboard at the centerline of the aircraft at FS 355.48. Access is through doors 81L or R.

13-13. **Aft Engine Drain Lines.** Three aft drain lines are provided to drain fuel at shutdown and in flight. The turbine frame drain line, located at FS 446.62 and BL 23.38, provides drainage of the turbine and afterburner sections at engine shutdown, after a wet pre-start, and for afterburner termination. The combustion chamber drain located at FS 442 and BL 23.38 provides drainage of the

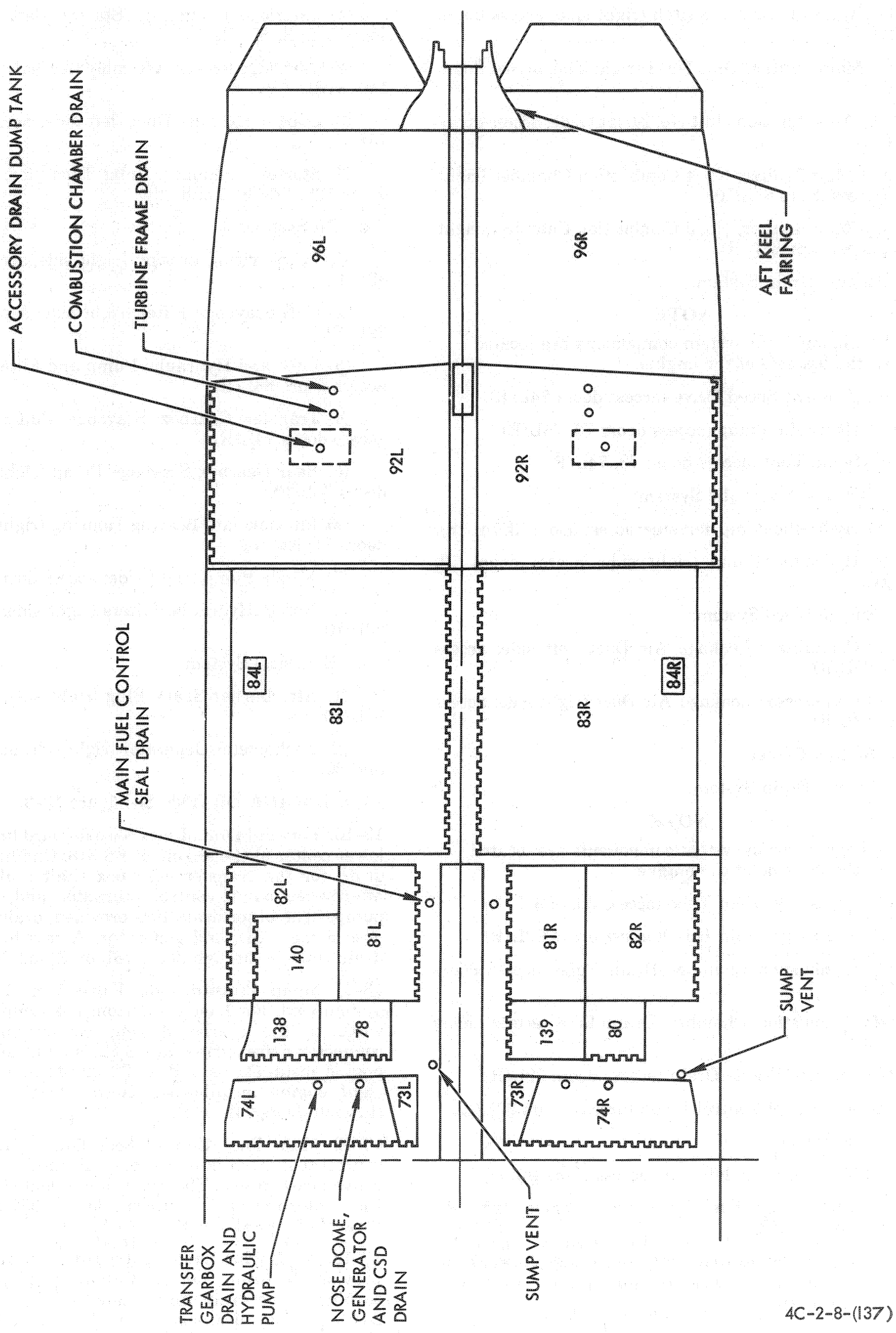


Figure 13-3. Engine Drains

engine combustion chambers after a false start or loss of fire has occurred. The afterburner pump scroll, the inlet guide vane actuators, the pressurizing and drain valve, the nozzle pump, and the torque booster have a common drain which empties into the accessory drain dump tank located at FS 436.54 and BL 31.85, in engine door 92L or R. The aft drain lines mate with their respective overboard connections on doors 92L or R and must be disconnected prior to opening these doors.

13-14. **Engine Accessories Drain Tank.** A drain tank mounted within access door 92L or R receives fuel that is drained from the engine fuel drain manifold on engine shutdown. The tank has the capacity for one shutdown and two false starts before it will start to overflow. The scarfed tube that protrudes through the bottom of access door 92 automatically siphons the fuel from the tank during flight. The straight tube that protrudes through the door serves as an overflow drain and as a vent to the tank.

13-15. **ENGINE COMPARTMENT SEALS.** Engine compartment seals are located on the engine access doors. These seals prevent loss of engine cooling and secondary airflow. Since the seals are easily damaged, extreme care should be observed when opening and closing these doors or when performing engine removal and installation procedures. Refer to T.O.1F-4C-3-1 series for detailed coverage on repair of engine compartment seals and classification of allowable damage.

13-16. **ENGINE MOUNTS.** See figure 13-4. Five mounting points are provided for attaching the engine to the airframe structure. Two mounts are forwarded on the engine, one at 12 o'clock and one at 9 o'clock on the left engine and one at 3 o'clock on the right engine compressor front frame. The engine main mount is located at 3 o'clock on the left engine and 9 o'clock on the right engine turbine frame. Two tangential mounts are on the turbine frame at 11 o'clock and 5 o'clock on left engine installations and at 1 o'clock and 7 o'clock on right engine installations.

13-17. **Forward Top Mount — BEFORE T.O.1F-4-991.** The forward top engine mounted link assembly supports the front end of the engine and acts as a guide during engine removal and installation. When the link engages the airframe mounted forward mount assembly, the mount is closed, raising the link from the installation and removal track. The engine vertical loads are supported, through the mount jaw, by the top mount bolt loaded in tension. Access to the top mount bolt is through doors 40L or R and 41L or R.

13-17A. **Forward Top Mount — AFTER T.O.1F-4-991.** The forward top engine mounted link assembly supports the front end of the engine and acts as a guide during engine removal and installation. When the link engages the airframe mounted forward mount assembly, the mount is closed, raising the link from the installation and removal track. The top mount bolt is loaded in compression and the mount jaw acts as a lever to support engine vertical loads. Access to the top mount bolt is through doors 40L or R and 41L or R.

13-18. **Forward Side Mount.** The forward side mount on the side centerline of the compressor front frame is used to take side load only. Access is provided by door 42L or R.

13-19. **Main Mount.** The main mount arrangement consists of three parts; the engine mount uniball, the airframe mounted clam type mount, and the removable main mount pin. There are three uniballs attached to the turbine frame, but only the inboard one is used in the mounting arrangement. The clam type mount attaches to the keel with a recess in the structure to provide clearance for removal and installation of the main mount pin. The main mount transmits engine thrust to the airframe. Linear growth of the engine due to thermal expansion is forward and aft of the main mount.

13-20. **Tangential Mounts.** The tangential mounts consist of a brace and trunnion which attach to the engine turbine frame. The tangential mounts take side and vertical loads only. Each engine requires a top outboard and bottom inboard brace link. The top outboard brace connects to the trunnion on the turbine frame at 40°30′ above the horizontal centerline of the engine and is accessible through door 54L or R. The bottom brace connects to the trunnion at 25° inboard from the vertical centerline of the engine and is accessible through access door 92L or R.

13-21. **Engine Removal and Installation Track.** The removal and installation track is mounted to the top of the engine bay directly in line with the forward top mount. The track supports the front of the engine during removal and installation. The engine mounted link assembly forms a distinct part of the forward top mount arrangement when the engine is installed and also functions as the connecting link between the engine and track during removal and installation. The link assembly rides in the track and when the engine is rolled completely forward in the bay the link is positioned so that it will be lifted from the track when the forward top mount is closed. A stop is incorporated at the aft end of the track to guard against accidental disengagement of the link from the track.

13-22. OPERATING INSTRUCTIONS.

13-23. **POST INSTALLATION RUNUP.** After engine installation, minor adjustment to exhaust gas temperature and/or RPM may be necessary due to installation effects. At the same time, other systems on the aircraft, which utilize electrical, hydraulic, and pneumatic power developed by the engine, can be checked for proper operation prior to flight. Refer to section II.

NOTE

Run up one engine at a time to determine that all components and subsystems of each engine are performing their required airframe function.

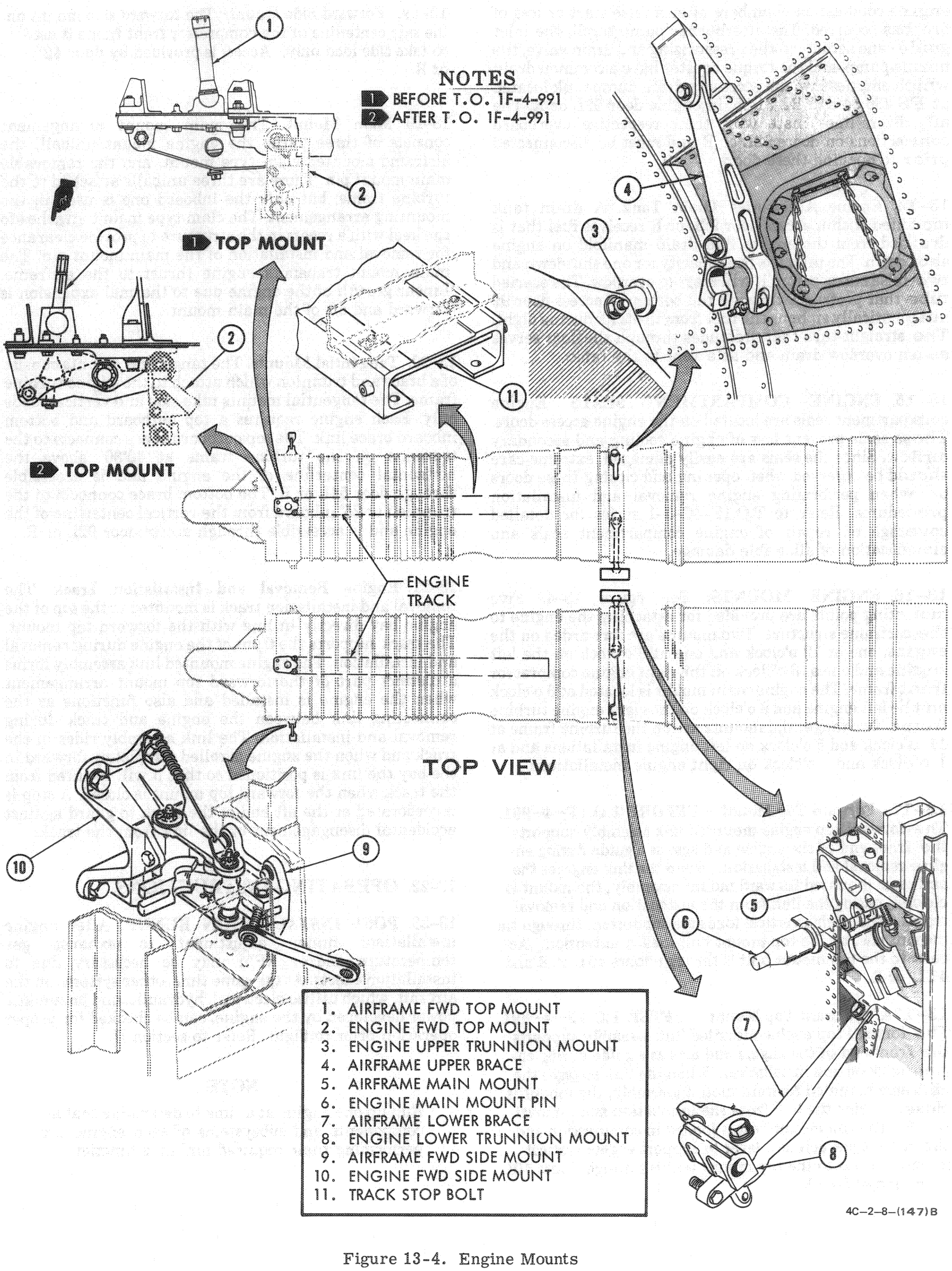


Figure 13-4. Engine Mounts

13-24. **FOREIGN OBJECT DAMAGE (FOD) PRECAUTIONS.** Cleaning of the engine inlet and nacelle area cannot be overemphasized to protect the engine from entry of foreign materials which will cause serious damage to the engine. The general precautions listed below should be adhered to at all times.

a. When transporting engines on dollies or trucks, assure the inlet sections of the engines are adequately covered.

b. When moving the aircraft to another location, tugs should be used in lieu of taxiing.

c. Vacuum clean all areas in and around engine inlet ducts and engine nacelles after any maintenance, or before and after installing an engine.

d. Use care when operating an engine on the ground. Use no more power than necessary to reduce the suction power of the engine.

e. Never wear loose clothing or carry rags or gloves in pockets when walking around engines in operation.

f. Install intake screens during ground runup and be alert for ice accumulation on screens.

TOOLS AND TEST EQUIPMENT.

13-25. GENERAL.

13-26. To perform maintenance on the system or components, special tools and test equipment listed in table 13-1 should be used. Alternate equipment with equal or greater range and accuracy than that stated in the Alternate Equipment column may be substituted.

Table 13-1. Tools and Test Equipment

Name	Identification No.	Alternate Equip. Range	Alternate Equip. Accuracy	Use
Transportation trailer	107640			Transport engine.
Work stand	3110			Engine maintenance.
Installation/removal trailer	4000A			To facilitate removal, transfer, and installation of the J79 engine.
Adapter set - ground handling multi-purpose	1C5277G1			Used with 48 inch rail system for engine buildup, maintenance, transportation, test, installation, and removal of engine.
Adapter set - transportation and installation	1C5279G1			Used with 1C5277G1 for transporting and testing of engines.
Set, rigging	1C3946G2			Throttle input linkage rigging.
Rig pin	1C2754-13G2 (part of 1C3946G2)			Throttle rigging.
Throttle gage kit	MDE323790-1			Engine throttle control box.
Main mount socket	Local manufacture (see figure 13-5)			Main mount eye bolt nuts.
Wrench, torque		0 to 150 inch-pounds		
Wrench, torque		100 to 750 inch-pounds		

13-27. ENGINE HANDLING EQUIPMENT.

13-28. Installation and Removal Trailer. The 4000 A/B trailer is used to remove, transfer, and install the J79 jet engine. Installation, transportation, and disassembly adapters are provided for the engine that mates with the trailer parallel rails and other elements of the parallel rail ground handling system. The engine mounts on the turbine frame and the compressor front frame serve as jack points during removal, transfer, and installation of the engine. Precision positioning of the engine is achieved through a combination of hydraulic actuators. These controls provide fore and aft tilt, roll, and yaw movement of the parallel rails. Refer to T O 35D3-3-34-1 for operation of the installation and removal trailer.

13-29. Handling Adapters. The 1C5277G1 multi—purpose ground handling adapters are used with the 4000A/B trailer and with the 107640 transportation trailer or equivalent trailers. Installation of the 1C5279G1 adapters to the 1C5277G1 adapters support the engine for ground or air transportation. A combination of 1C5279G1 and 1C5280G1 and adapters used with the 1C5277G1 multi—purpose adapters and an appropriate stand support the engine for ground test. Refer to T O 35DA3—6—20—1 for operation of engine handling adapters.

13-30. MAIN ENGINE MOUNT SOCKET. See figure 13-5. An extra deep 11/16 inch 12 point socket is required for the main mount eyebolt nuts.

AIRCRAFT MAINTENANCE

13-31. GENERAL

13-32. TORQUE VALUES. Torque values applicable to basic engine and its components are listed in figure 13-6.

13-33. SERVICING.

13-34. DRAIN TANK SIPHONING. Before door 92 L or R is lowered, siphon drain tank. See figure 13-7.

13-35. ENGINE ACCESS DOOR BOLT LUBRICATION. Lubricate engine access door bolts each time doors are lowered. See figure 13-8.

13-36. AFT FUSELAGE FINGERSEAL LUBRICATION. Lubricate fingerseals each time engine is removed. See figure 13-8.

13-37. MAIN MOUNT EYE BOLT LUBRICATION. Lubricate main mount eye bolts each time mount is opened. See figure 13-9.

13-38. REPLACEMENT AND ADJUSTMENT.

13-39. ENGINE REPLACEMENT.

NOTE

Engine Roll Back is to be used for access to forward engine bay areas wherein complete engine removal is not required.

13-40. Tools and Equipment.

Trailer, installation/removal
Trailer, transportation
Adapter, ground handling, multi-purpose
Adapter, transportation and installation
Rig pin

13-41. Materials.

Solvent, P-D-680, Type II
Grease, MIL-G-3545
Grease, MIL-L-25681
Grease, MIL-T-5544
Grease, MIL-G-25760
Grease, MIL-G-21164
Anti-seize compound, MIL-A-907
Lockwire, MS20995NC41
Lockwire, MS20995NC32
Gasket (4 req'd), MAD-06-005
Gasket (3 reqd), 50887—450—S
Magnesium Oxide (milk of magnesia), 6605—684—8868
Lockwire, MS20995NC20

13-42. Manpower Requirement.

a. Four men required.

13-43. Removal.

a. If required, remove centerline armament. Refer to TO 1F-4C-2-18.

b. If required, remove centerline fuel tank. Refer to TO 1F-4C-2-10.

b1. Perform cartridge start system checkout. Refer to TO 1F-4C-6WC-4.

c. Apply external hydraulic power.

d. Apply external electrical power.

e. Configure aircraft as follows:

(1) Tail hook-UP and install safety

(2) Flaps - UP

(3) Speed brakes - OPEN and install safety struts

WARNING

To prevent fuel spillage, which could result in serious fire, steps f thru m must be performed in sequence.

f. Position LEFT or RIGHT ENGINE MASTER switch to ON.

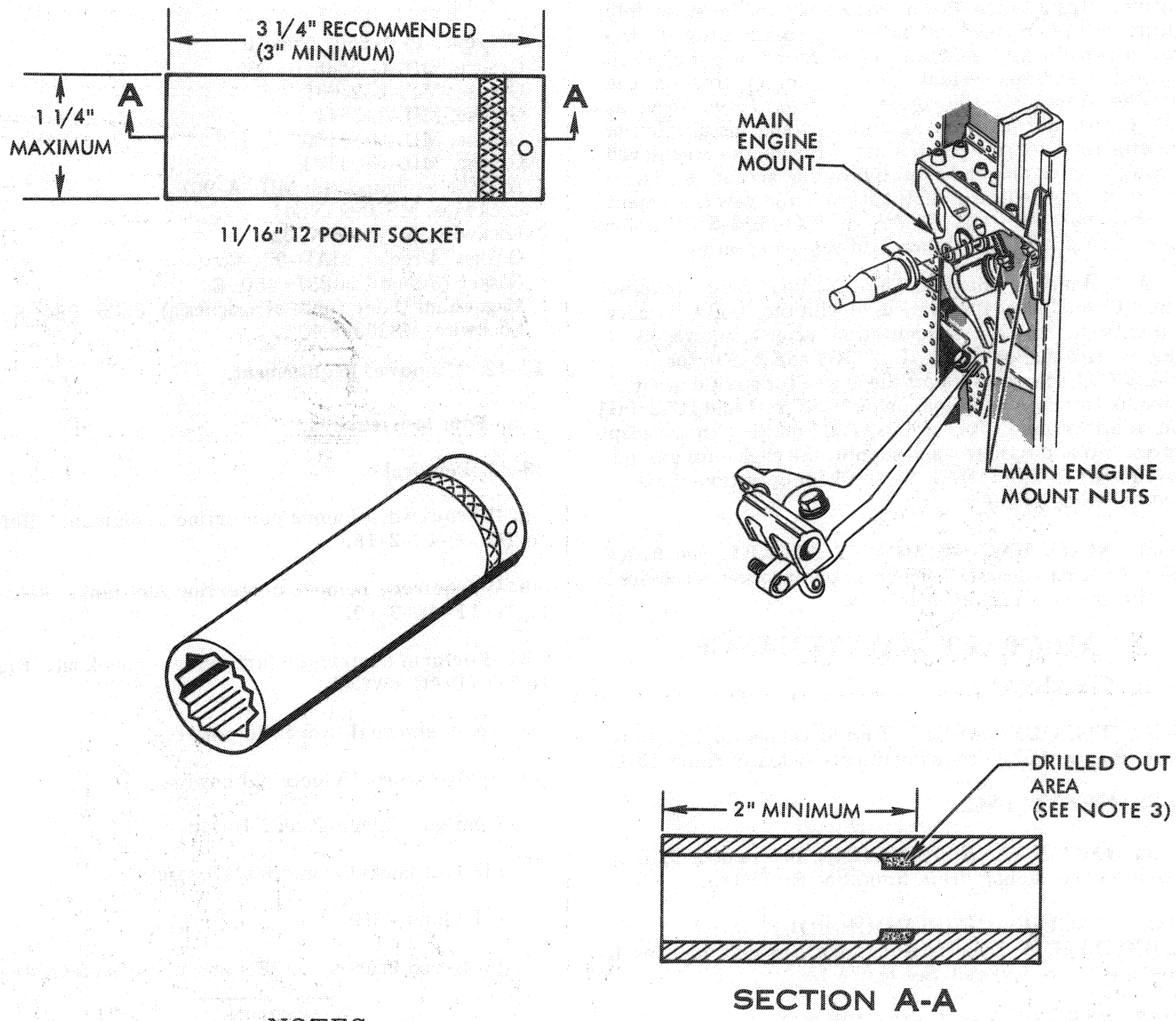
g. Position left or right throttle to OFF.

h. Set RH or LH MAIN FUEL CONT circuit breaker.

i. Position LEFT or RIGHT ENGINE MASTER switch to OFF.

j. Pull RH or LH MAIN FUEL CONT circuit breaker.

k. Lockwire LEFT or RIGHT ENGINE MASTER switch to OFF position.



NOTES

1. AN EXTRA DEEP SOCKET IS REQUIRED TO OPEN AND CLOSE THE MAIN ENGINE MOUNT. THE SOCKET MUST HAVE AN INSIDE DIAMETER OF NOT LESS THAN 11/16 INCHES FOR A DEPTH OF AT LEAST 2 INCHES. IF A SOCKET IS NOT AVAILABLE THAT MEETS THE ABOVE REQUIREMENTS, ONE MAY BE MODIFIED AS SHOWN.
2. A SOCKET WITH A MODERATELY THICK WALL SHOULD BE USED TO PREVENT BREAKAGE. SEE MAXIMUM ALLOWABLE O D DIMENSION.
3. DRILL OUT THE INSIDE OF THE SOCKET TO A DEPTH OF BETWEEN 2" TO 2 1/8" INCHES WITH AN 11/16 INCH DRILL BIT.
4. A ONE INCH 6 POINT SOCKET WITH ABOVE DIMENSIONS MAY BE USED AS AN ALTERNATE.

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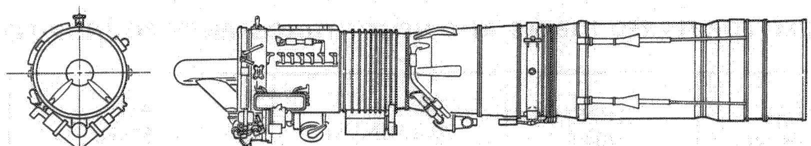
Figure 13–5. Main Engine Mount Socket

TORQUE VALUES FOR J79 ENGINE



TORQUE WRENCH SIZE		
TORQUE BETWEEN	TORQUE WRENCH	TOLERANCE
0-25 IN-LB	30 IN-LB	± 1 IN-LB
25-140 IN-LB	150 IN-LB	± 5 IN-LB
140-550 IN-LB	600 IN-LB	± 20 IN-LB
30-140 FT-LB	150 FT-LB	±5 PT-LB
140-240 FT-LB	250 FT-LB	±10 FT-LB
240-1000 FT-LB	1000 FT-LB	± 20 FT-LB

TORQUE VALUES FOR PLUGS AND UNIONS USED IN BOSSES AND UNIVERSAL BULKHEAD FITTING LOCKNUTS		
TUBING O.D.	DASH NO.	TORQUE VALUE
1/8	2	40-50 LB-IN
3/16	3	90-100 LB-IN
1/4	4	135-150 LB-IN
5/16	5	155-175 LB-IN
3/8	6	180-200 LB-IN
1/2	8	270-300 LB-IN
5/8	10	360-400 LB-IN
3/4	12	45-50 LB-FT
1	16	58-70 LB-FT
1 1/4	20	75-87 LB-FT
1 1/2	24	83-100 LB-FT

STANDARD TORQUE VALUES FOR SELF-LOCKING NUTS	
DIAMETER AND THREADS PER INCH	TORQUE VALUES
8-32	20 TO 25 IN-LB
10-32	30 TO 45 IN-LB
1/4-28	60 TO 95 IN-LB
5/16-24	130 TO 180 IN-LB
3/8-24	260 TO 320 IN-LB
7/16-20	400 TO 490 IN-LB

AEROQUIP HOSE FITTINGS		
NOMINAL LINE SIZE	DASH NO.	TORQUE VALUES
3/16	3	8-10 FT-LB
1/4	4	10-12 FT-LB
5/16	5	12-15 FT-LB
3/8	6	15-18 FT-LB
1/2	8	23-28 FT-LB
5/8	10	40-45 FT-LB
3/4	12	55-60 FT-LB
1	16	70-75 FT-LB
1 1/4	20	85-90 FT-LB

STANDARD TORQUE VALUES FOR SILVER-PLATED LOCKNUTS	
DIAMETER AND THREADS PER INCH	TORQUE VALUES
10-32	24 TO 27 IN-LB
1/4-28	55 TO 70 IN-LB
5/16-24	100 TO 130 IN-LB
3/8-24	190 TO 230 IN-LB
7/16-20	300 TO 360 IN-LB

TORQUE VALUES FOR STANDARD STEEL BOLTS AND NUTS		
DIAMETER AND THREADS PER INCH	SIZE	TORQUE VALUES
NC 8-32	0.164	13 TO 16 IN-LB
10-24	0.190	20 TO 23 IN-LB
1/4-20	0.250	40 TO 60 IN-LB
5/16-18	0.3125	70 TO 110 IN-LB
3/8-16	0.375	160 TO 210 IN-LB
7/16-14	0.4375	250 TO 320 IN-LB
1/2-13	0.500	420 TO 510 IN-LB
NF 8-36	0.164	16 TO 19 IN-LB
10-32	0.190	24 TO 27 IN-LB
1/4-28	0.250	55 TO 70 IN-LB
5/16-24	0.3125	100 TO 130 IN-LB
3/8-24	0.375	190 TO 230 IN-LB
7/16-20	0.4375	300 TO 360 IN-LB
1/2-20	0.500	480 TO 570 IN-LB

TORQUE VALUES FOR JAM NUTS OR FITTINGS USED WITHOUT GASKETS OR O-RINGS				
TUBE OD (INCHES)	TUBE DASH NO.	THREAD SIZE	ALUMINUM OR ALLOY	STEEL
1/8 (.125)	2	0.3125-24	35 TO 50 IN-LB	
3/16 (.1875)	3	0.375-24	65 TO 80 IN-LB	70 TO 90 IN-LB
1/4 (.250)	4	0.4375-20	90 TO 105 IN-LB	110 TO 130 IN-LB
5/16 (.3125)	5	0.500-20	105 TO 125 IN-LB	140 TO 160 IN-LB
3/8 (.375)	6	0.5625-20	125 TO 145 IN-LB	225 TO 275 IN-LB
1/2 (.500)	8	0.750-16	240 TO 280 IN-LB	400 TO 450 IN-LB
5/8 (.625)	10	0.875-14	330 TO 370 IN-LB	550 TO 650 IN-LB
3/4 (.750)	12	1.0625-12	45 TO 55 FT-LB	70 TO 80 FT-LB
1 (1.000)	16	1.3125-12	70 TO 80 FT-LB	85 TO 100 FT-LB
1 1/4 (1.250)	20	1.615-12	80 TO 100 FT-LB	
1 1/2 (1.500)	24	1.875-12	100 TO 120 FT-LB	

4C-2-8-(154-1)

Figure 13-6. Engine Torque Values (Sheet 1 of 2)

TORQUE VALUES FOR FLARED TUBING AND HOSE FITTINGS (INCH POUNDS/FOOT POUNDS)					
TUBE OD (INCHES)	TUBE DASH NO.	THREAD SIZE	ALL ALUMINUM PARTS	ALL STEEL PARTS	STEEL TUBE - ALUMINUM OR STEEL NUTS
1/8 (0.125)	2	0.3125-24		35 TO 40 IN-LB	35 TO 40 IN-LB
3/16 (0.1875)	3	0.375-24	30 TO 50 IN-LB	90 TO 100 IN-LB	90 TO 100 IN-LB
1/4 (0.250)	4	0.4375-20	40 TO 65 IN-LB	135 TO 150 IN-LB	135 TO 150 IN-LB
5/16 (0.3125)	5	0.500-20	60 TO 80 IN-LB	180 TO 200 IN-LB	180 TO 200 IN-LB
3/8 (0.375)	6	0.5625-20	75 TO 125 IN-LB	270 TO 300 IN-LB	270 TO 300 IN-LB
1/2 (0.500)	8	0.750-16	150 TO 250 IN-LB	450 TO 500 IN-LB	450 TO 550 IN-LB
5/8 (0.625)	10	0.875-14	200 TO 350 IN-LB	650 TO 700 IN-LB	650 TO 770 IN-LB
3/9 (0.750)	12	1.0625-12	25 TO 41 FT-LB	75 TO 83 FT-LB	75 TO 91 FT-LB
1 (1.000)	16	1.3125-12	41 TO 58 FT-LB	100 TO 116 FT-LB	100 TO 128 FT-LB
1 1/4 (1.250)	20	1.625-12	50 TO 75 FT-LB	125 TO 150 FT-LB	125 TO 150 FT-LB
1 1/2 (1.500)	24	1.875-12	50 TO 75 FT-LB	158 TO 183 FT-LB	158 TO 183 FT-LB

NOTES

1. USE ONE HALF OF TORQUE VALUES LISTED FOR STANDARD STEEL BOLTS AND NUTS WHEN USING THIN STEEL NUTS, FOR BOLTS OF ALLOYS OTHER THAN STEEL, AND FOR ALL BOLTS THREADED DIRECTLY INTO MAGNESIUM OR OTHER NON-FERROUS ALLOYS.
2. WHEN TORQUE IS APPLIED TO BOLT HEAD, USE HIGHER TORQUE VALUE. WHEN TORQUE IS APPLIED TO NUT, USE LOWER TORQUE VALUE.
3. VALUES GIVEN FOR TUBING PROVIDE FOR THE THREADS BEING LUBRICATED.
4. TO CONVERT TO FOOT POUNDS, DIVIDE INCH POUNDS BY 12. TO CONVERT TO INCH POUNDS, MULTIPLY FOOT POUNDS BY 12.
5. WHEN USING A PNEUMATIC IMPACT WRENCH TO INSTALL NUTS, APPLY FINAL TORQUE BY USING THE HAND TORQUE WRENCH.
6. USE A TORQUE WRENCH SUITED TO THE PART BEING TIGHTENED; CALIBRATE PERIODICALLY TO ENSURE ACCURACY; AND APPLY CORRECTION FACTOR TO TORQUE READINGS WHEN EXTENSIONS ARE USED. SELECT SUITABLE TORQUE WRENCH, AS INDICATEDIN THE TORQUE WRENCH SIZE TABLE.
7. FOR PROPER USE OF EXTENSIONS, REFER TO SECTION I.

4C-2-8-(154-2)

Figure 13-6. Engine Torque Values (Sheet 2 of 2)

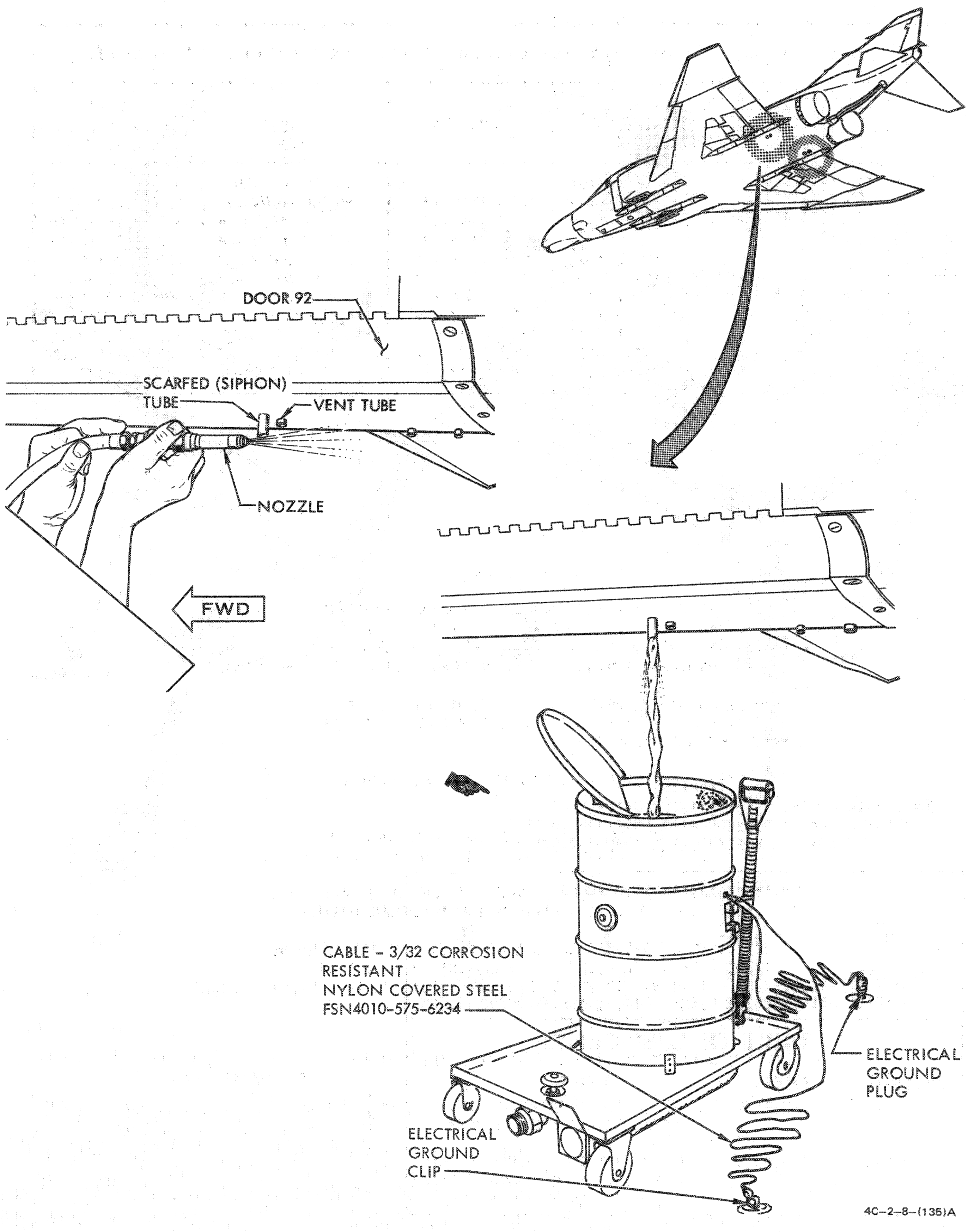
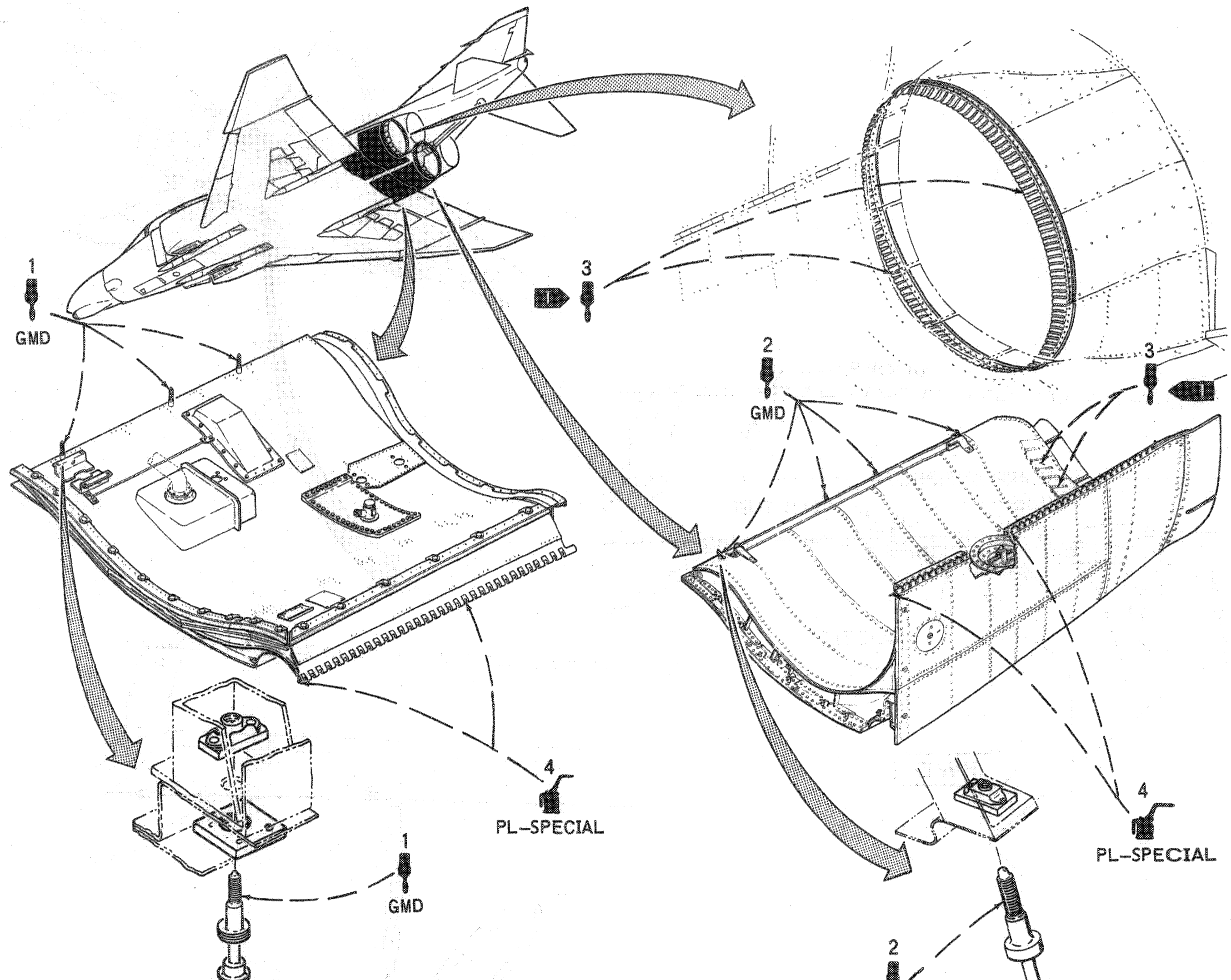
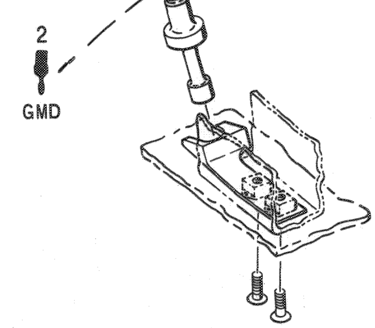


Figure 13-7. Drain Tank Siphoning





NOTE

1 LUBRICATE THE ENGINE ACCESS DOOR AFT FUSELAGE FINGERSEAL INTERFACES AND AREA CONTACTED BY SEAL FINGERS WITH LUBRICATING OIL (MIL-L-25681).

APPLICATION SYMBOLS

OIL CAN	GUN	BRUSH	HAND

---DASHED LINES INDICATE LUBRICATING POINTS ON OPPOSITE SIDE

TABLE OF LUBRICANTS

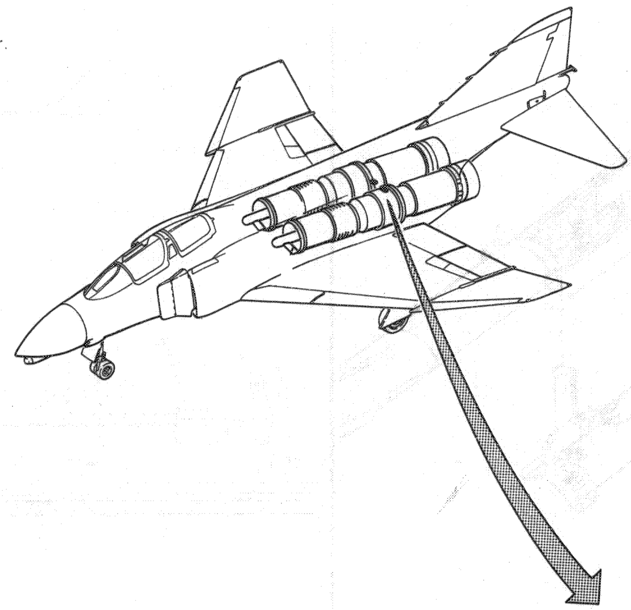
SYMBOL	SPEC.	TYPE
GMD.......	MIL-G-21164....	GREASE, MOLYBDENUM DISULFIDE (FOR LOW AND HIGH TEMPERATURE)
PL-SPECIAL..	VV-L-800.......	LUBRICATING OIL, GENERAL PURPOSE, PRESERVATIVE (WATER DISPLACING, LOW TEMPERATURE)

NOMENCLATURE

1 DOOR 92L/R ATTACH BOLT
2 DOOR 96L/R ATTACH BOLT
3 VARIABLE NOZZLE FINGERSEAL INTERFACES
4 HINGE PIN

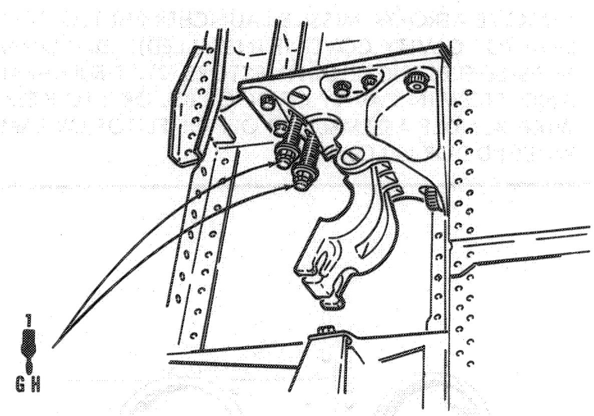
4C-2-8-(73)

Figure 13-8. Engine Access Door and Aft Fuselage Fingerseal Lubrication



NOMENCLATURE

1 MAIN ENGINE MOUNT EYE BOLTS



APPLICATION SYMBOLS

OIL CAN	GUN	BRUSH	HAND

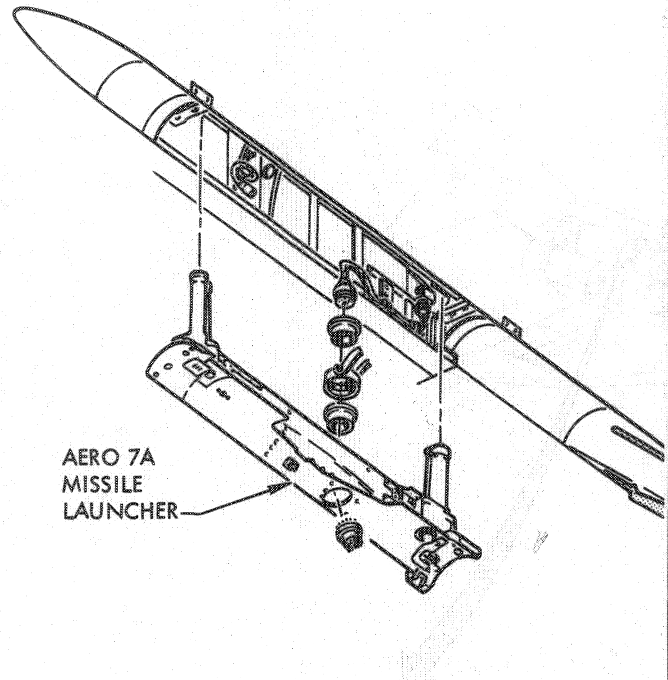
---DASHED LINES INDICATE LUBRICATING POINTS ON OPPOSITE SIDE

TABLE OF LUBRICANTS

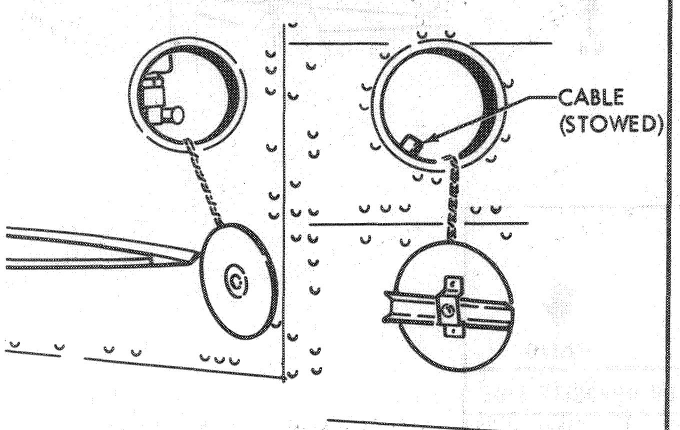
SYMBOL	SPEC.	TYPE
GH.........	MIL-G-81322.....	GREASE, AIRCRAFT, HIGH TEMPERATURE

4C-2-8-(74)A

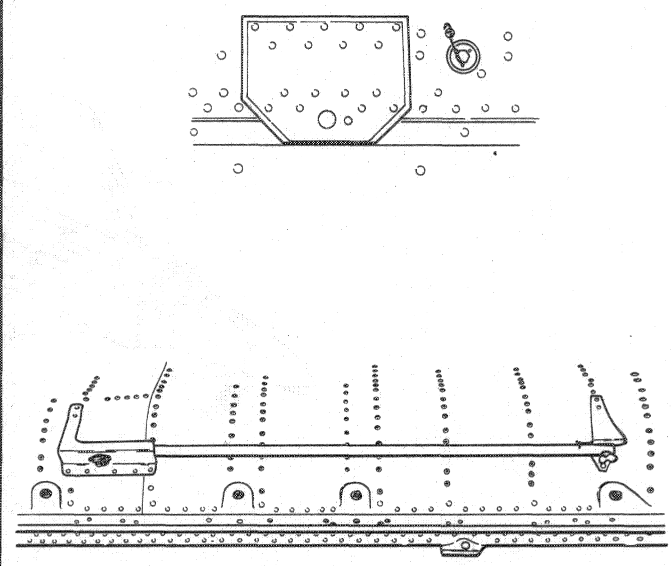
Figure 13-9. Main Engine Mount Eye Bolt Lubrication

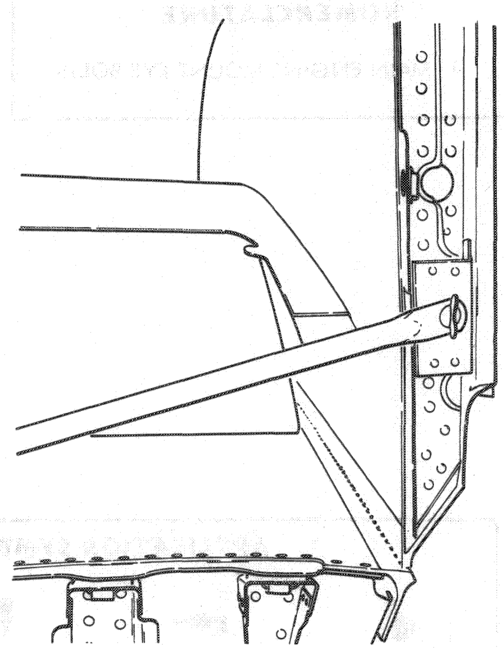


1. REMOVE AERO-7A MISSILE LAUNCHER PER T.O.1F-4C-2-18 (OR CAVITY COVER IF INSTALLED). DISCONNECT MISSILE ELECTRICAL CONNECTORS (2) AT BULKHEAD AND STOW IN CAVITY OF DOOR 83L OR R TO KEEP WIRE BUNDLE ASSEMBLY UP OFF OF FLOOR OR RAMP WHEN DOOR IS LOWERED.



2. REMOVE DOORS 118 L OR R AND 119 L OR R. DISCONNECT COAX CABLE AND STOW INSIDE DOOR 96 L OR R.





CAUTION

DISCONNECT CABLE THROUGH DOORS 118 AND 119 PRIOR TO OPENING DOOR 96 OR DAMAGE TO CABLE WILL RESULT.

3. OPEN DOOR 96 L OR R, PROP OPEN WITH STRUT STOWED INSIDE.

4C-2-8-(153-1)A

Figure 13-10. Engine Access Door Opening (Sheet 1 of 7)

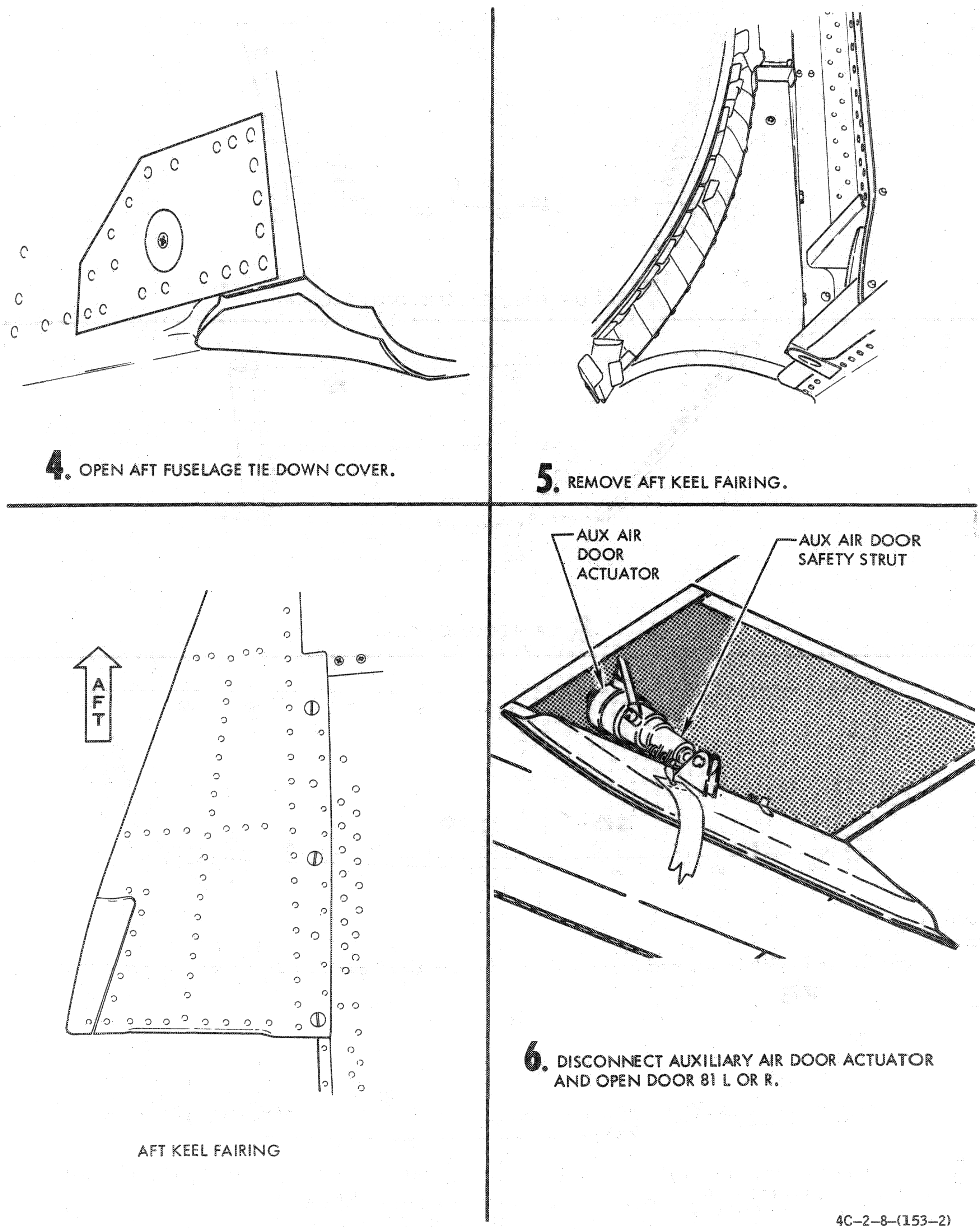
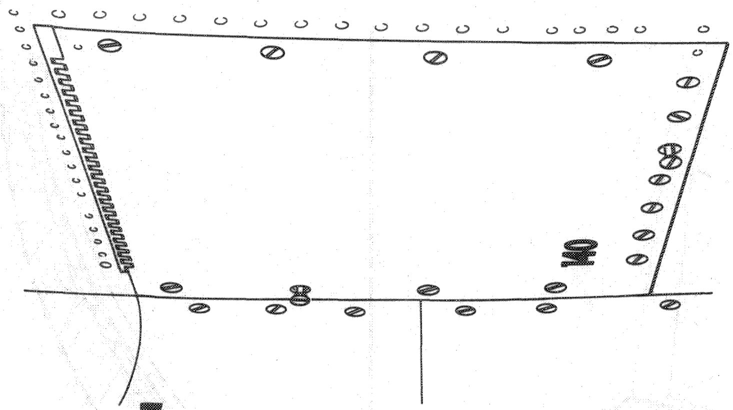
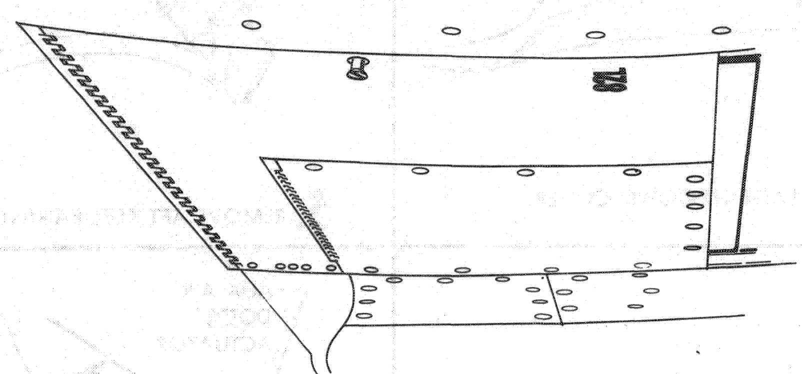


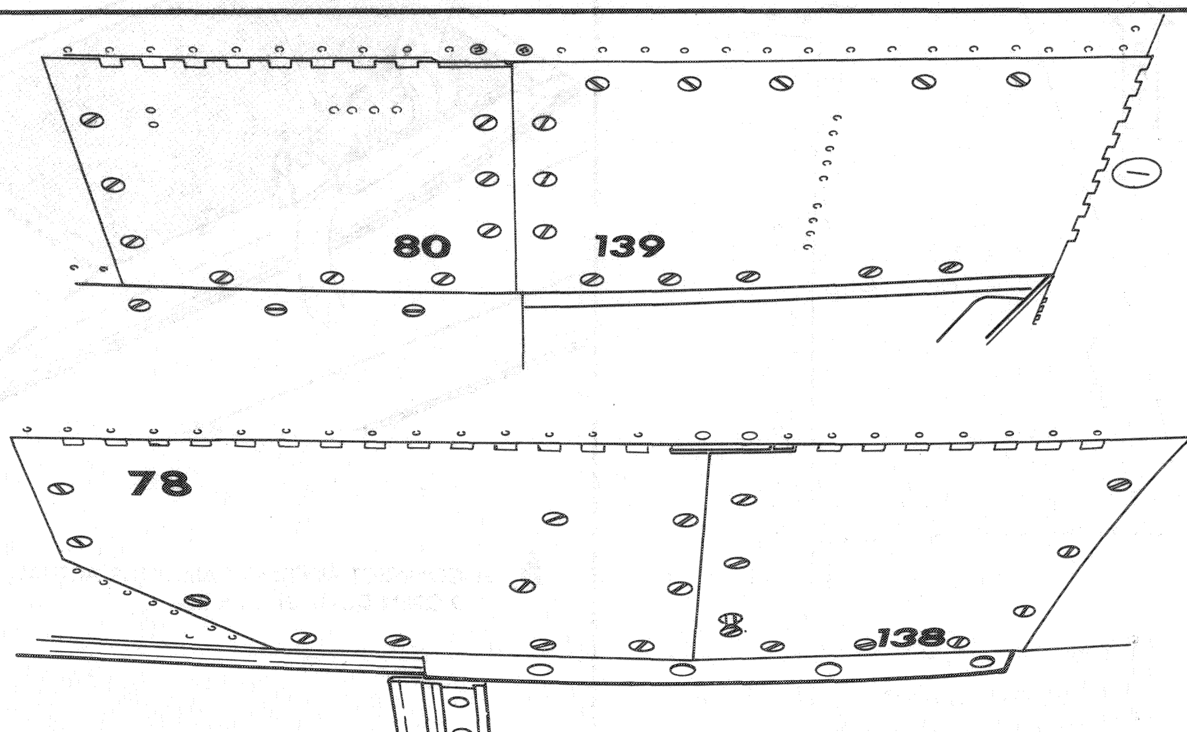
Figure 13-10. Engine Access Door Opening (Sheet 2 of 7)



7. FOR LEFT ENGINE ACCESS, OPEN DOOR 140.



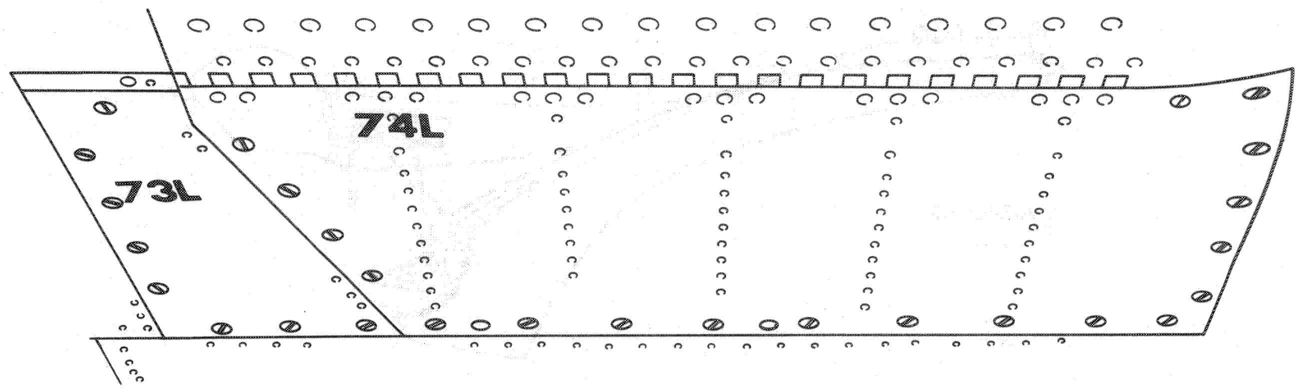
8. OPEN DOOR 82 L OR R.



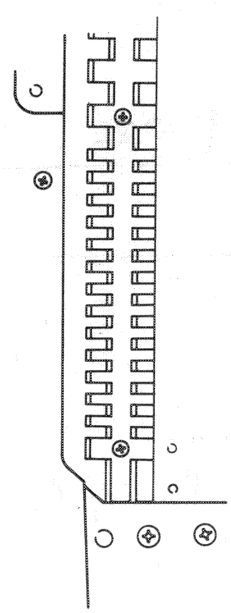
9. OPEN DOORS 78 AND 138 FOR LEFT ENGINE ACCESS OR DOORS 80 AND 139 FOR RIGHT ENGINE ACCESS

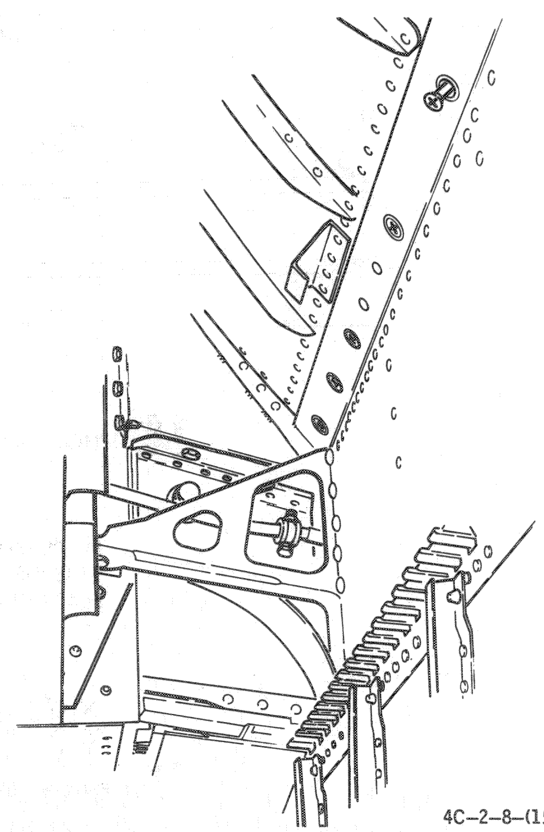
4C-2-8-(153-3)

Figure 13-10. Engine Access Door Opening (Sheet 3 of 7)



10. OPEN DOORS 73 L OR R AND 74 L OR R.



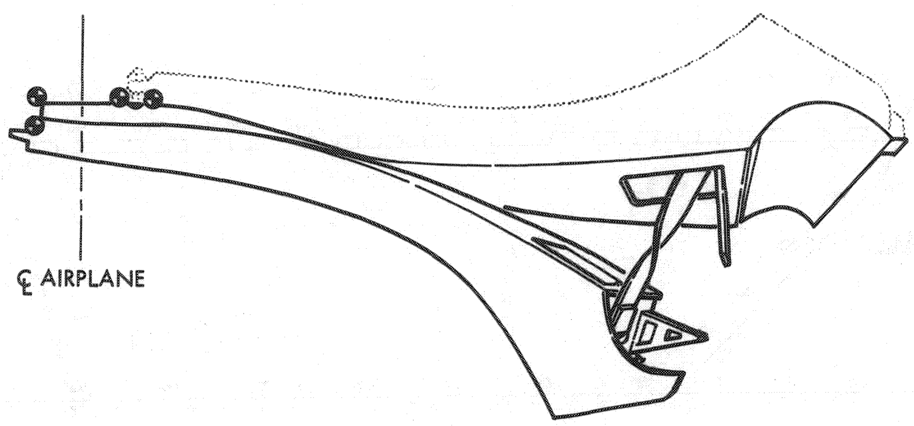


11. OPEN DOOR 84 L OR R.

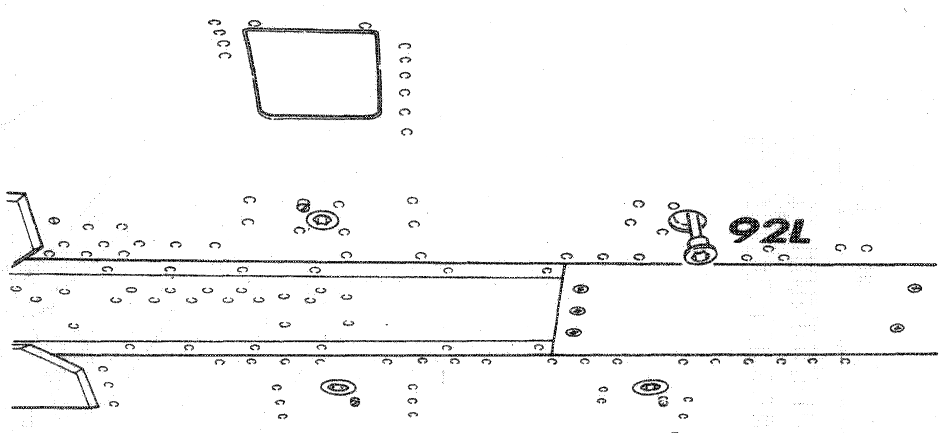
12. REMOVE DOUBLE HINGE SCREWS AND OPEN DOOR 83 L OR R.

4C-2-8-(153-4)

Figure 13-10. Engine Access Door Opening (Sheet 4 of 7)



13. USE STRAP TO HOLD DOOR 83 L OR R OPEN.



14. SIPHON DOOR 92 L OR R DRAIN TANK.

CAUTION

FLAPS MUST BE UP BEFORE DOOR
92 IS OPENED OR DAMAGE TO
FLAPS COULD RESULT.

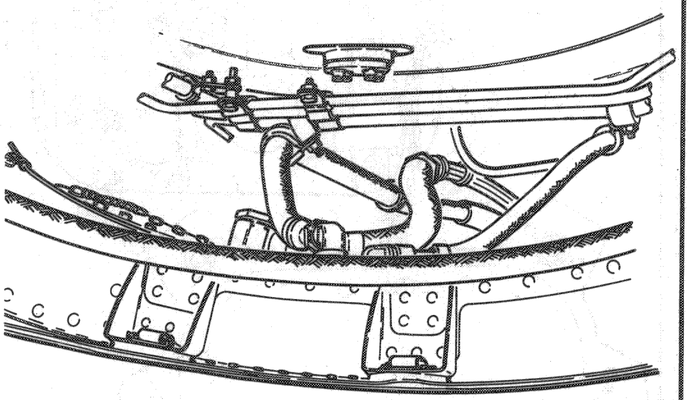
NOTE

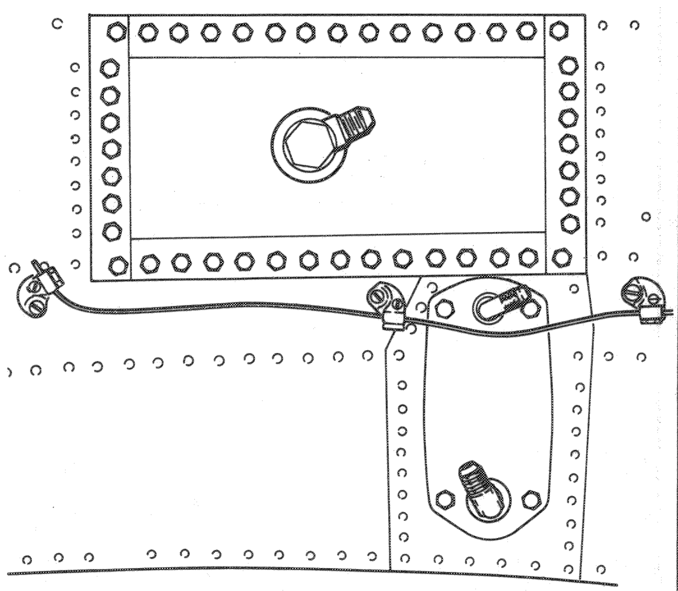
DOORS 83 AND 96 MUST BE OPENED
BEFORE DOOR 92.

15. OPEN DOOR 92 L OR R APPROXIMATELY 2 INCHES.

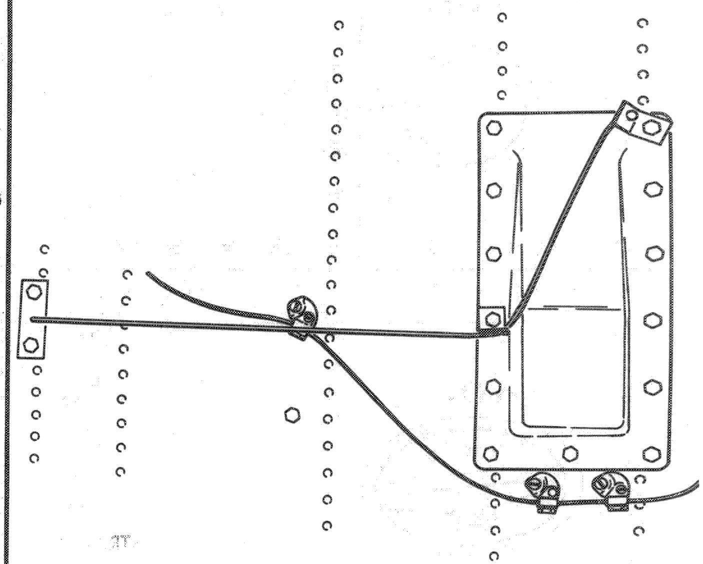
4C-2-8-(153-5)

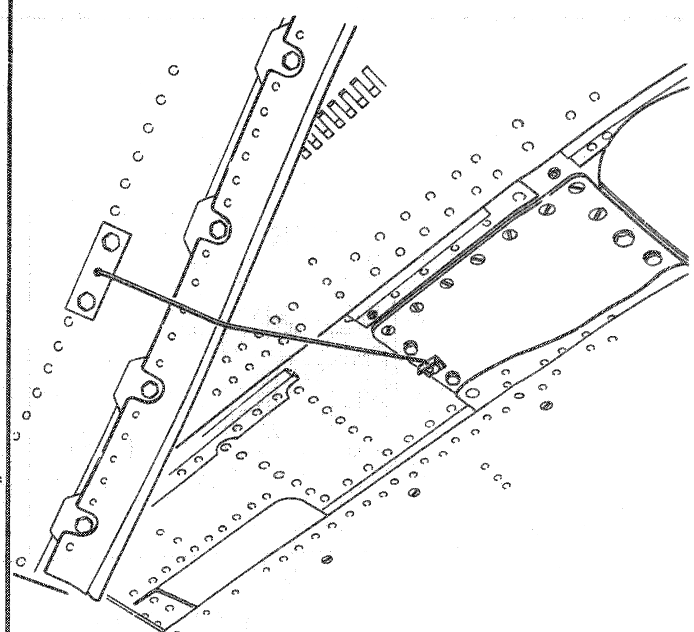
Figure 13-10. Engine Access Door Opening (Sheet 5 of 7)





16. DISCONNECT THREE DRAIN LINES FROM INSIDE DOOR 92 L OR R AND LOWER DOOR.





17. REMOVE DOOR RESTRAINT CABLE FROM INSIDE DOOR 92 L OR R.

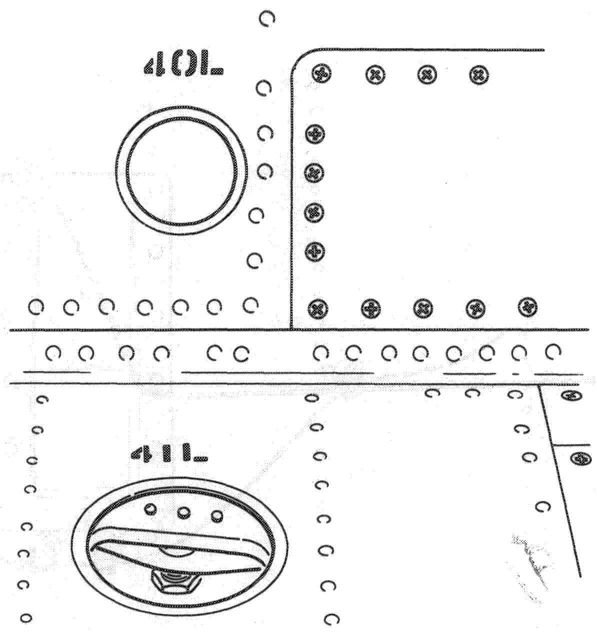
NOTE

SPEED BRAKES MUST BE OPEN TO INSTALL DOOR RESTRAINT.

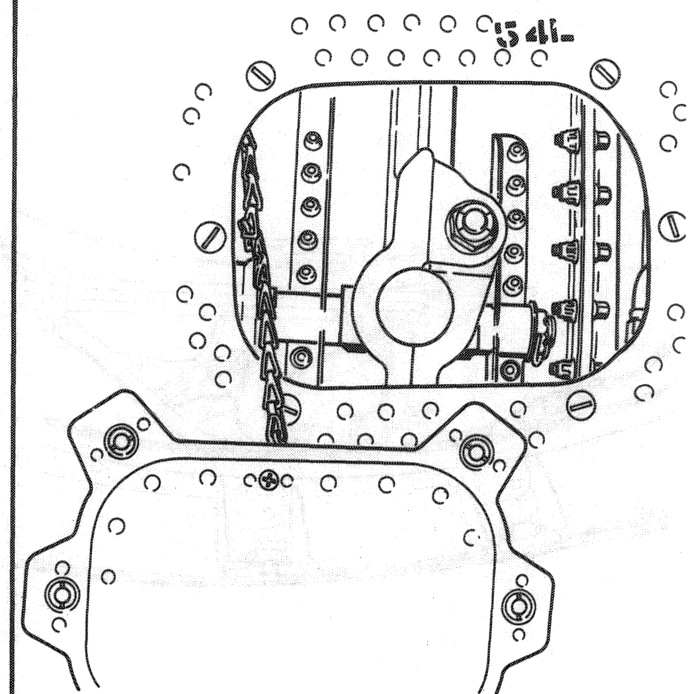
18. REMOVE BOLT INSIDE SPEED BRAKE AND INSTALL RESTRAINT CABLE.

4C-2-8-(153-6)

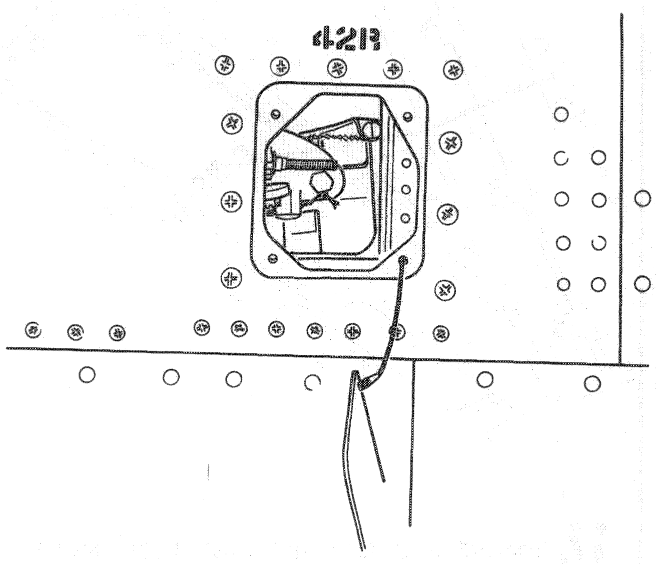
Figure 13-10. Engine Access Door Opening (Sheet 6 of 7)



19. REMOVE DOORS 40 L OR R AND 41 L OR R.



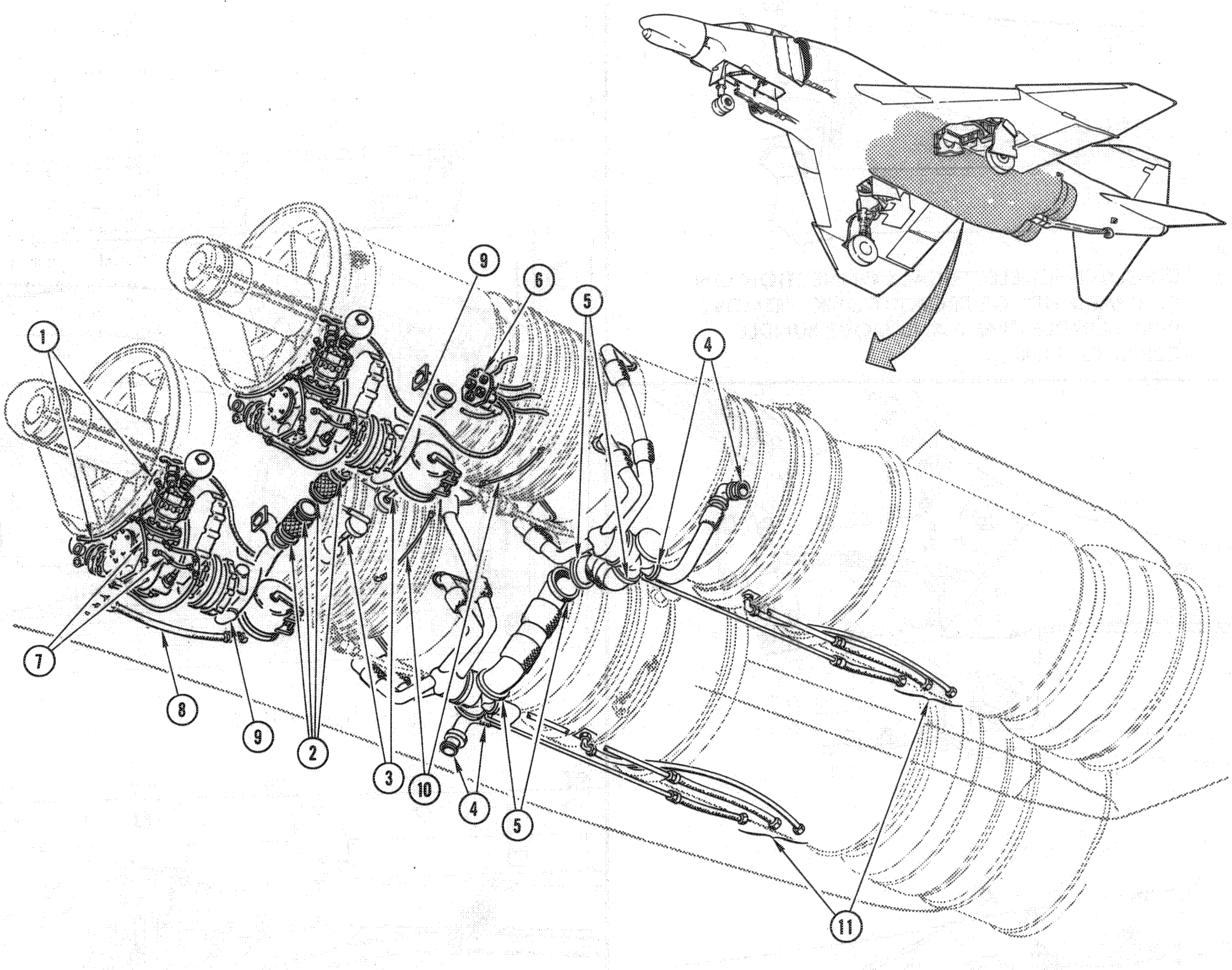
21. REMOVE DOOR 54 L OR R.



20. REMOVE DOOR 42 L OR R.

4C-2-8-(153-7)

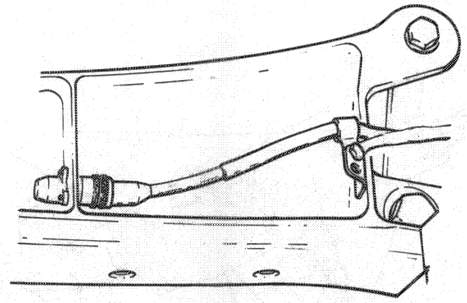
Figure 13-10. Engine Access Door Opening (Sheet 7 of 7)



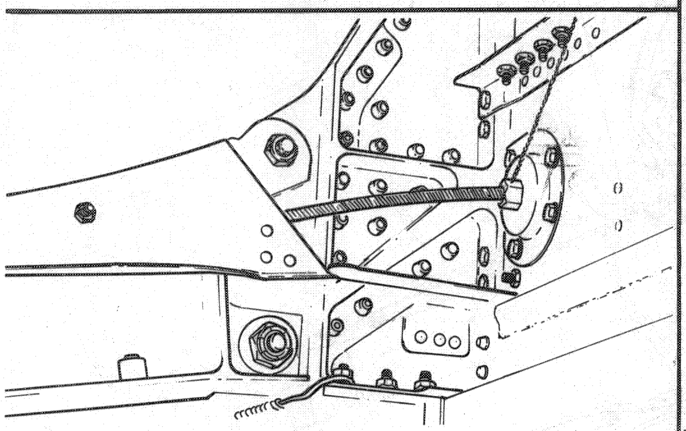
1. HYDRAULIC PUMPS
2. FUEL INLET MANIFOLD
3. ENGINE THROTTLE
4. TRAILING EDGE BLEED AIR DUCTS
5. MAIN BLEED AIR DUCT
6. ELECTRICAL
7. FORWARD ENGINE DRAIN LINES
8. SUMP VENT LINE
9. STARTER DUCT CONNECTIONS
10. MAIN FUEL CONTROL DRAIN
11. AFT ENGINE DRAIN LINES

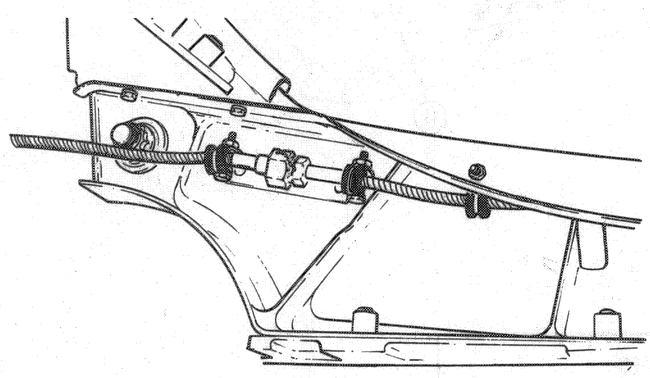
4C-2-8-(75)

Figure 13-11. Engine Connecting Points



1. DISCONNECT ELECTRICAL CONNECTION ON FORWARD SIDE OF DROPOUT LINK. REMOVE WIRE BUNDLE CLAMP AND MOVE BUNDLE CLEAR OF LINK.





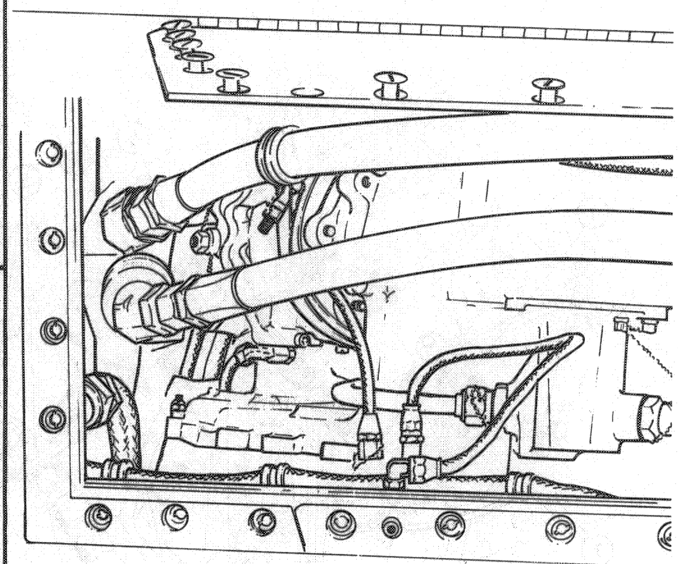
2. REMOVE DROPOUT LINK.

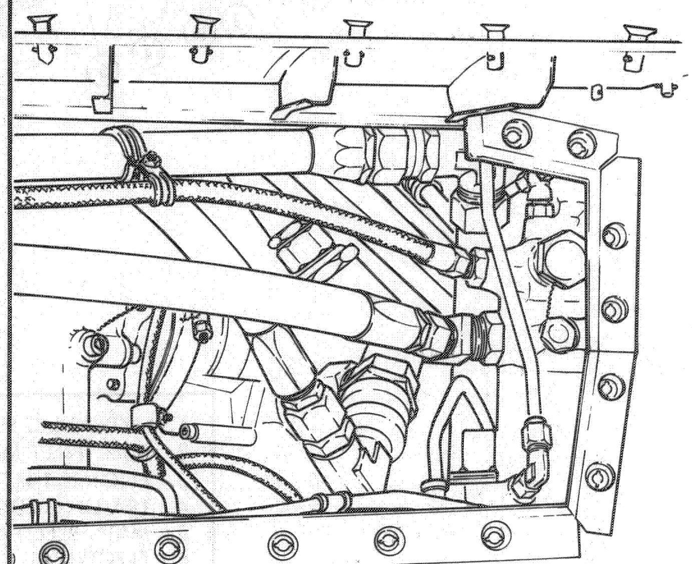
a. DISCONNECT AILERON TRIM FLEX SHAFT AT BOTH INBOARD AND OUTBOARD ENDS OF DROPOUT LINK. DISCONNECT SHAFT CLAMP FROM OUTBOARD END OF LINK.

CAUTION

DO NOT TOW OR JACK AIRCRAFT WHILE DROPOUT LINK IS REMOVED OR STRUCTURAL DAMAGE WILL RESULT.

b. REMOVE DROPOUT LINK ATTACH BOLTS AND LOWER LINK FROM COMPARTMENT.

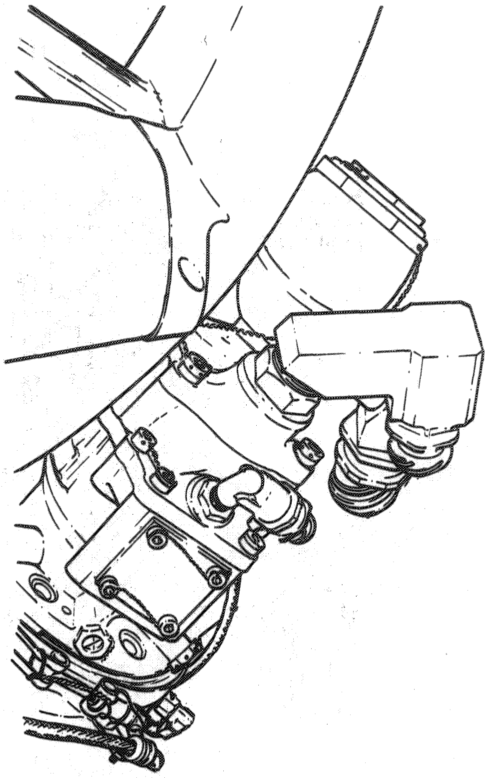




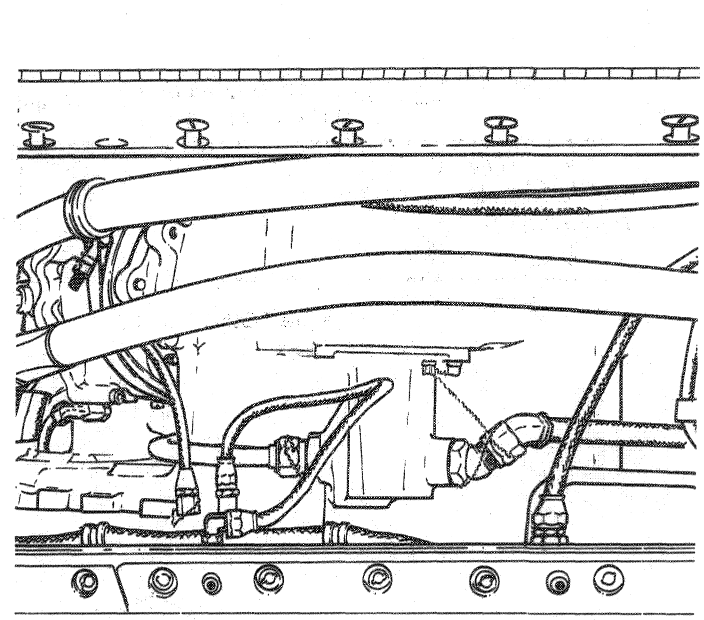
3. DISCONNECT HYDRAULIC LINES AT HYDRAULIC PUMPS AND DISCONNECT PUMP RETAINING CLAMPS.

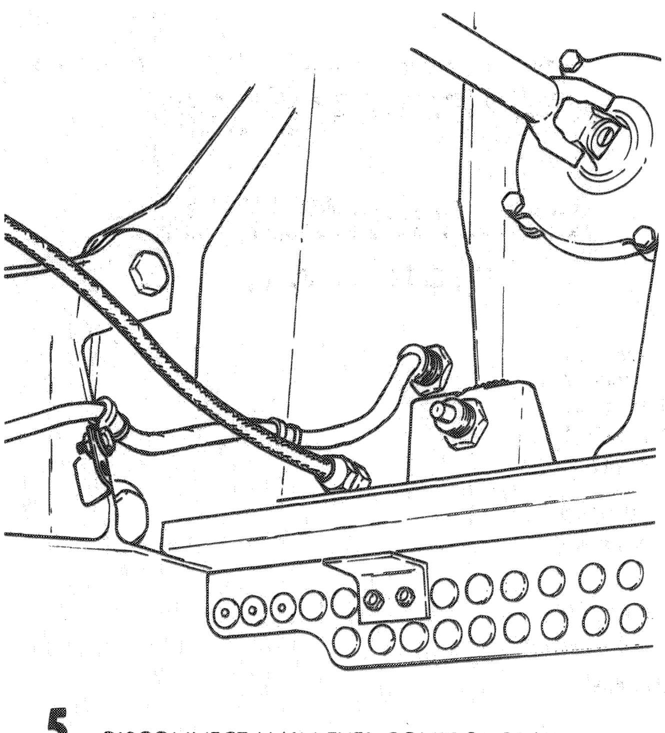
4C-2-8-(170-1)

Figure 13-12. Engine Disconnection (Sheet 1 of 5)

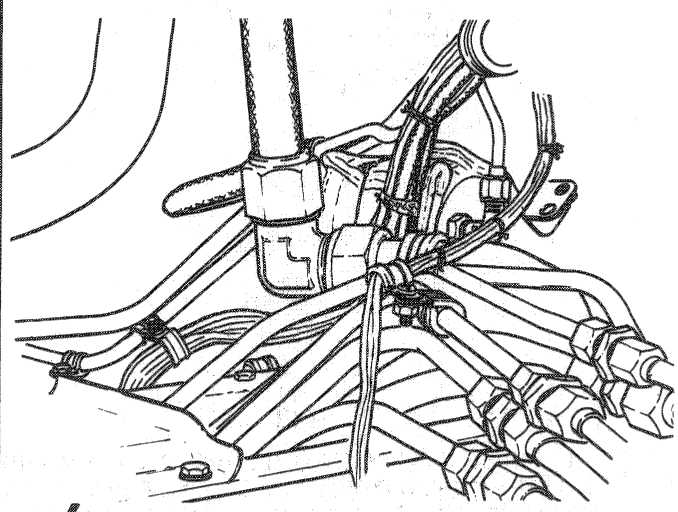


4. CAP ALL LINES AND FITTINGS.





5. DISCONNECT MAIN FUEL CONTROL DRAIN LINE AT KEEL.

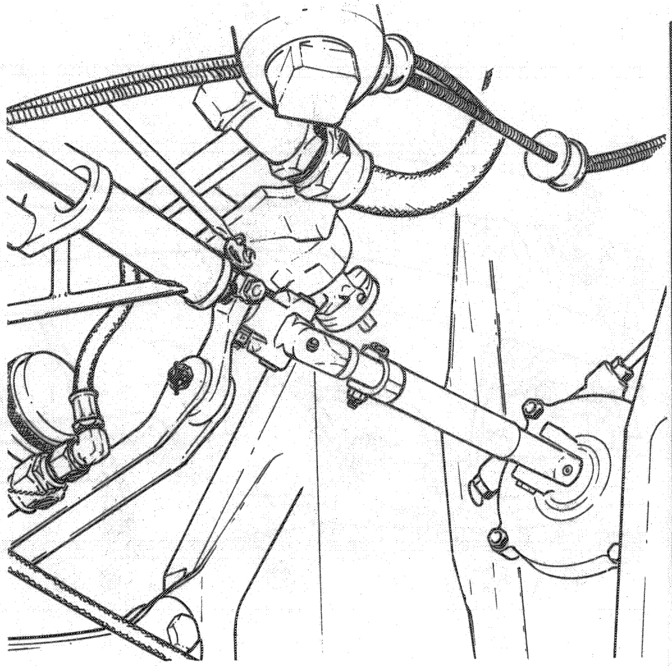


6. DISCONNECT SUMP PRESSURIZATION VALVE VENT LINE, ENGINE GEARBOX DRAIN LINE, GENERATOR DRAIN LINE, AND CSD NOSE DOME DRAIN LINE. LOOSEN CLAMPS ON CSD INLET AND OUTLET LINES AT FUEL INLET MANIFOLD BRACKET AND MOVE LINES TO GAIN CLEARANCE FOR REMOVAL.

7. CAP ALL LINES AND FITTINGS AND TIE DRAIN LINES TO ENGINE.

4C-2-8-(170-2)A

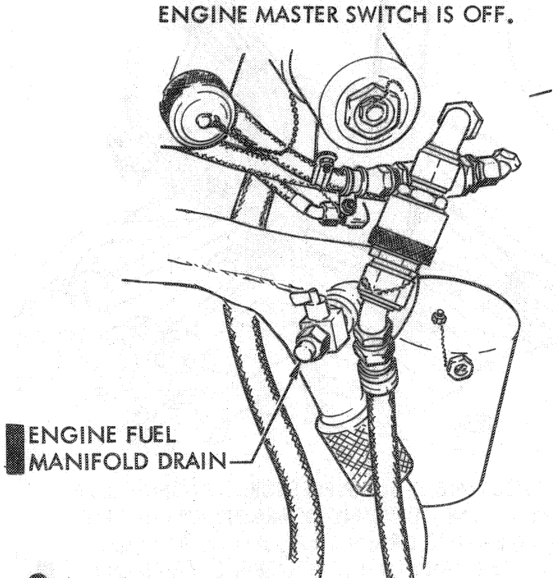
Figure 13-12. Engine Disconnection (Sheet 2 of 5)



8. DISCONNECT THROTTLE SHAFT AND ALLOW SHAFT TO SWING TOWARD KEEL.

CAUTION

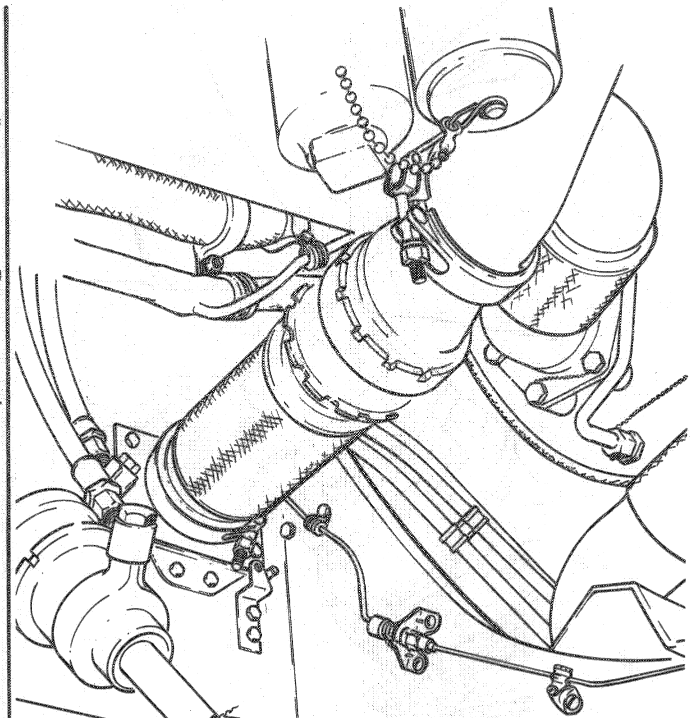
ASSURE THROTTLE IS OFF AND ENGINE MASTER SWITCH IS OFF.



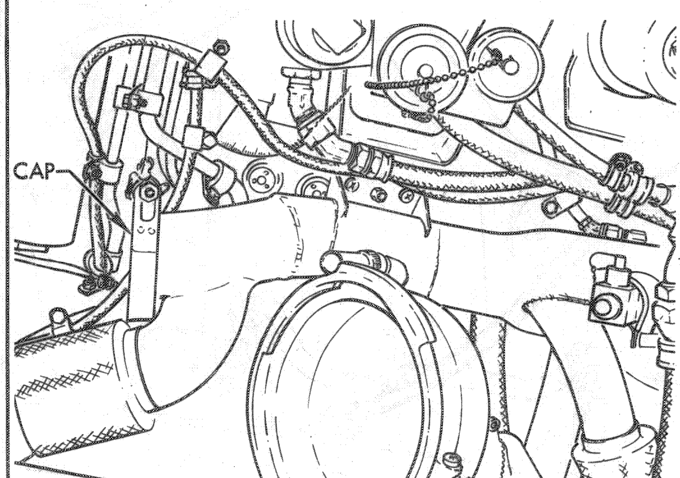
9. PERFORM ENGINE FUEL MANIFOLD DRAINING AS FOLLOWS:

a. VISUALLY MAKE SURE ENGINE FUEL SHUTOFF VALVE INDICATOR IN DOOR 22 READS CLOSED. IF VALVE INDICATOR READS OPEN, REPEAT STEPS f THRU k OF PARAGRAPH 13-43.

b. OPEN ENGINE FUEL MANIFOLD DRAIN AND EMPTY INTO A SUITABLE CONTAINER.



10. DISCONNECT AND REMOVE INLET FUEL DISCONNECT ASSEMBLY.



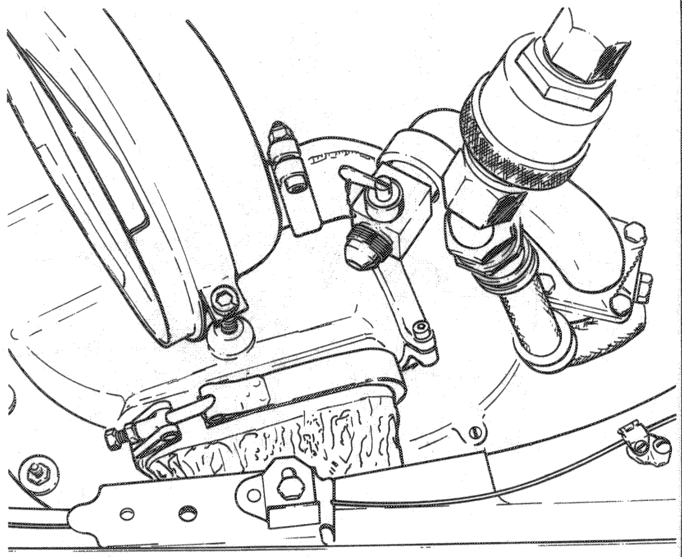
11. REMOVE CAP, SEAL, AND CLAMP FROM ENGINE FUEL MANIFOLD AND INSTALL ON KEEL FUEL FLANGE.

12. TORQUE COUPLING NUT 60 TO 80 INCH-POUNDS.

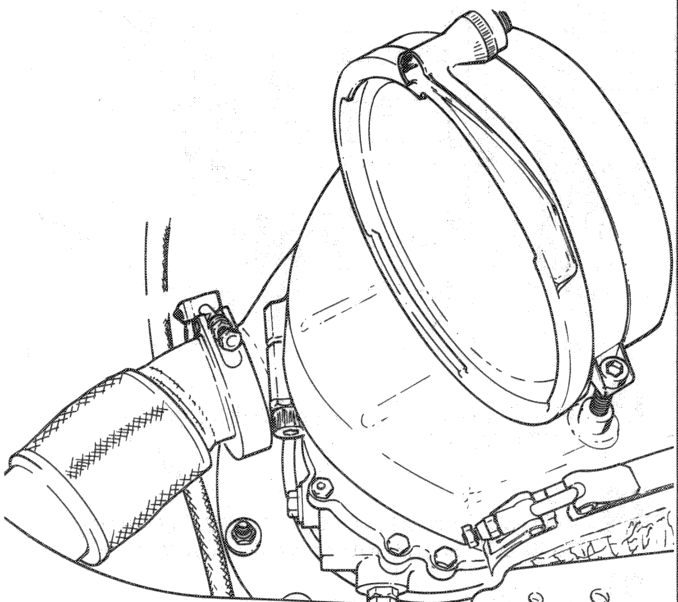
13. CAP ENGINE FUEL MANIFOLD AND INLET FUEL DISCONNECT OPENINGS.

4C-2-8-(170-3)A

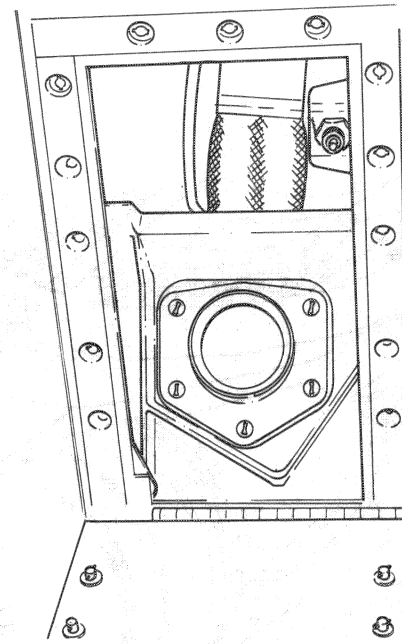
Figure 13-12. Engine Disconnection (Sheet 3 of 5)



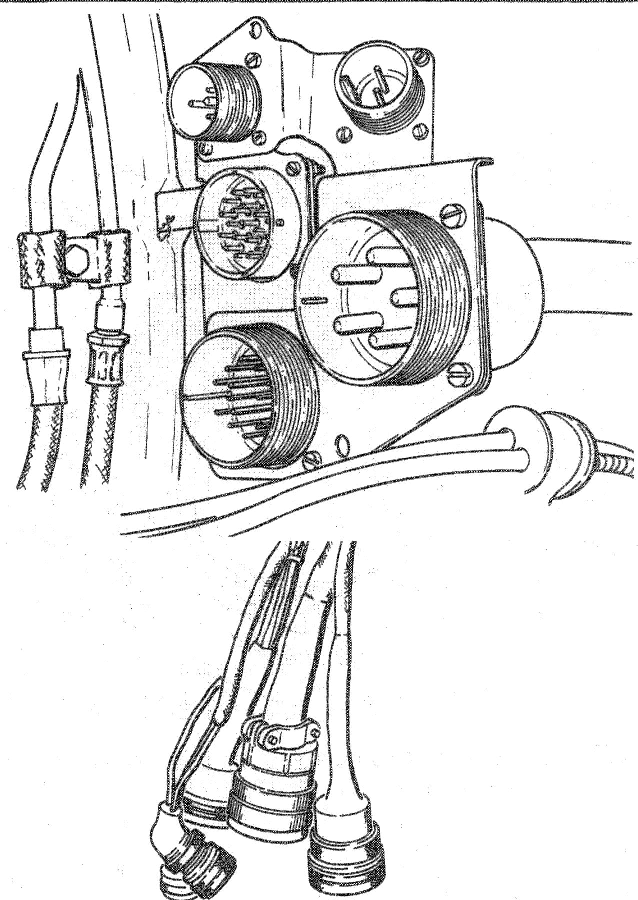
14. DISCONNECT STARTER EXHAUST DUCT CLAMP AND REMOVE EXHAUST DUCT.



15. DISCONNECT STARTER PNEUMATIC DUCT CLAMP.



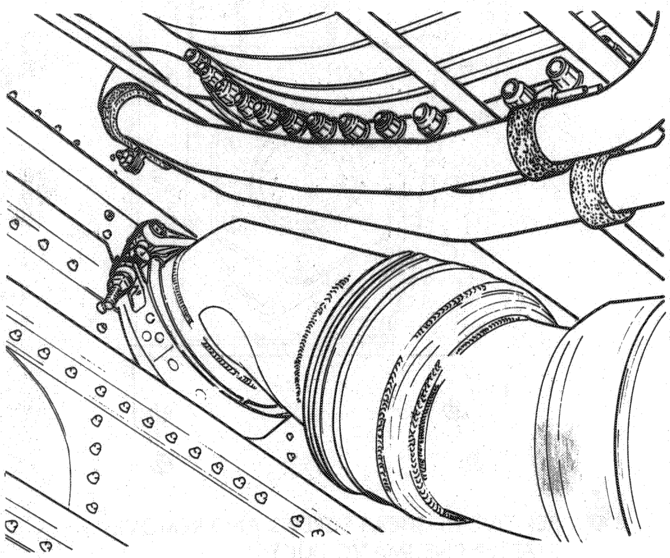
16. REMOVE HI-SHEAR SCREWS AND REMOVE STARTER PNEUMATIC DUCT.

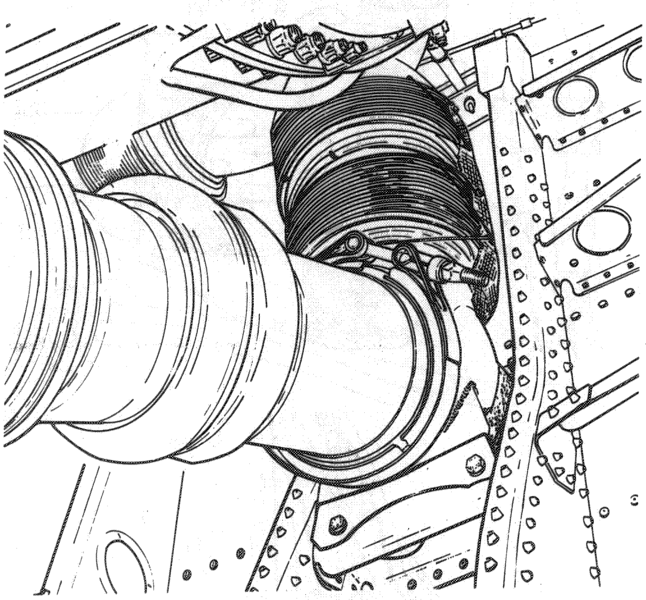


17. DISCONNECT FIVE ELECTRICAL CONNECTORS FROM ENGINE AND TIE BUNDLES TO STRUCTURE.

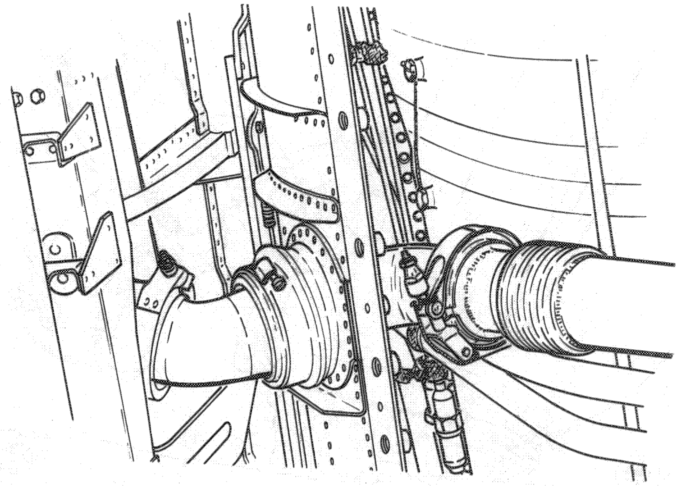
4C-2-8-(170-4)

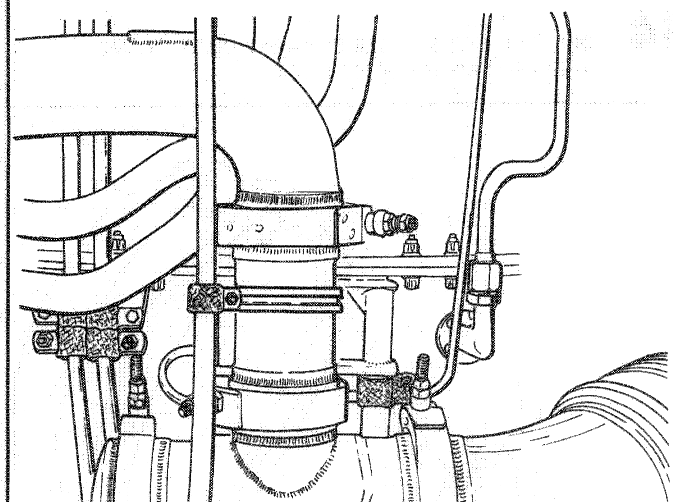
Figure 13-12. Engine Disconnection (Sheet 4 of 5)





18. DISCONNECT MAIN BLEED AIR DUCT FROM KEEL AND ENGINE. REMOVE DUCT.





19. DISCONNECT TRAILING EDGE BOUNDARY LAYER CONTROL DUCT.

20. RELEASE GANG LEVER ON REMOVABLE SHROUD AND LOWER SHROUD FROM COMPARTMENT.

21. CAP ALL LINES.

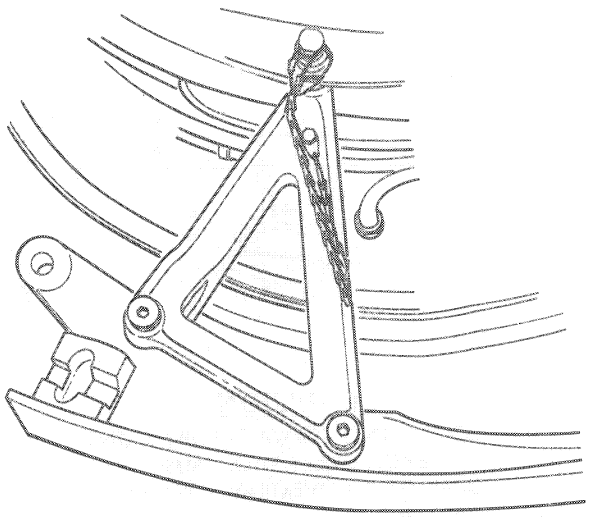
WARNING

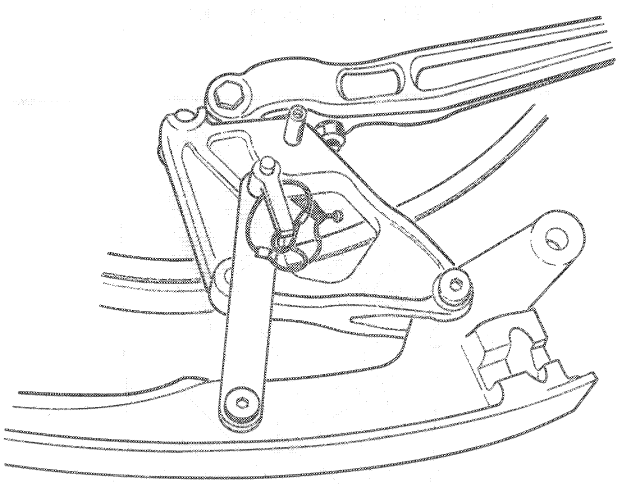
ASSURE HYDRAULIC POWER IS NOT CONNECTED TO AIRCRAFT.

22. RAISE MAIN LANDING GEAR INBOARD DOOR AND TIE UP WITH LOCKWIRE.

4C-2-8-(170-5)

Figure 13-12. Engine Disconnection (Sheet 5 of 5)



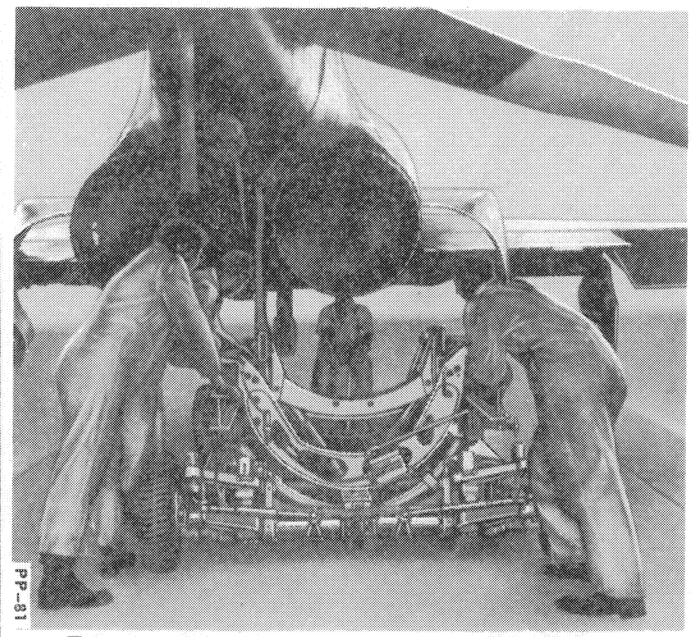


1. ATTACH AFT ADAPTER AND LOWER RING ASSEMBLY TO ENGINE AT TURBINE FRAME.

2. LOWER FRONT AND REAR CRADLE ASSEMBLIES.

3. RAISE AND POSITION INSTALLATION RISERS.

4. ZERO ALL TRAILER CONTROLS.



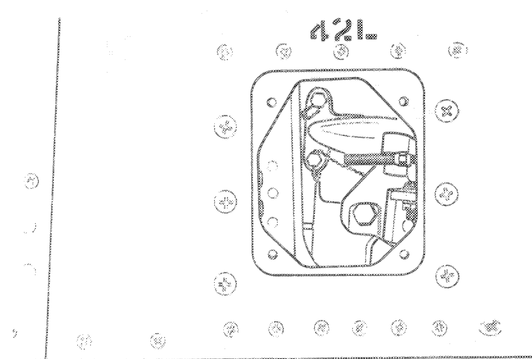
5. MOVE TRAILER UNDER ENGINE AND ALIGN TRAILER TO CENTERLINE OF ENGINE. BRAKE TRAILER.

6. ALIGN REAR CRADLE WITH VERTICAL CENTERLINE OF TURBINE FRAME.

WARNING

FAILURE TO ENSURE REAR ADAPTER ROLLERS ARE LOCKED COULD RESULT IN PERSONNEL INJURY OR LOSS OF LIFE.

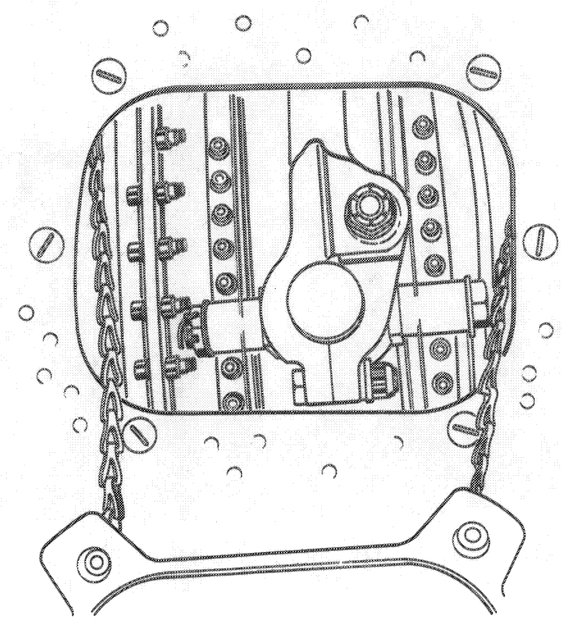
7. PUMP UP REAR CRADLE UNTIL RISER PINS ENGAGE HOLES IN LOWER RING SEGMENT. LOCK REAR ADAPTER ROLLERS. CONTINUE PUMPING UP CRADLE UNTIL ENGINE WEIGHT IS UNLOADED FROM AFT MOUNTS.



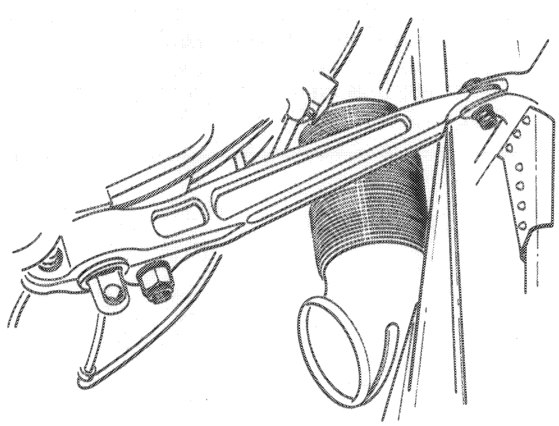
8. THROUGH DOOR 42 L OR R, DISCONNECT FORWARD SIDE MOUNT, SWING MOUNT FORWARD AGAINST ENGINE.

4C—2—8—(76—1)C

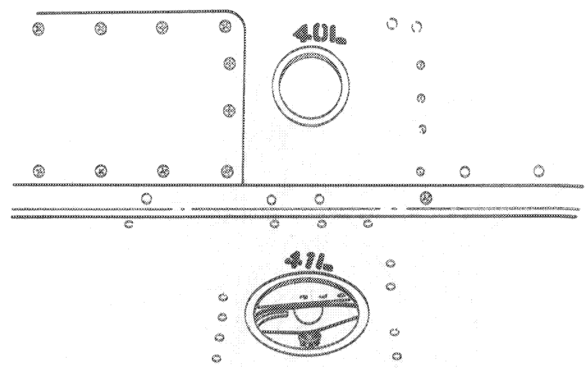
Figure 13-13. Engine Removal (Sheet 1 of 6)



9. THROUGH DOOR 54 L OR R, DISCONNECT UPPER TANGENTIAL BRACE FROM ENGINE.



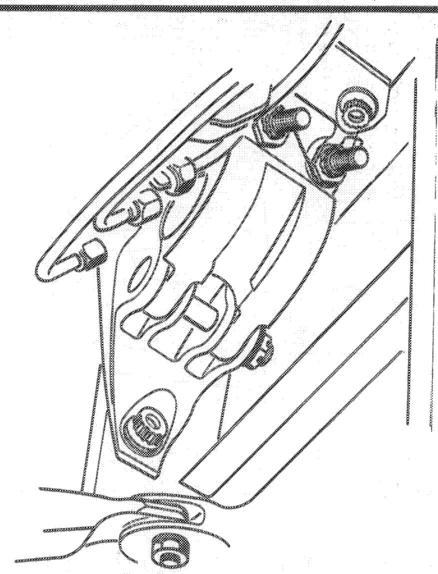
10. DISCONNECT AND REMOVE LOWER TANGENTIAL BRACE.



CAUTION

LOOSENING FORWARD TOP MOUNT JAW EXCESSIVELY WILL CAUSE DAMAGE TO OVERTRAVEL WASHER AND NUT.

11. THROUGH DOORS 40 L OR R AND 41 L OR R, LOOSEN FORWARD TOP MOUNT ENOUGH TO DISENGAGE JAW FROM MOUNT ROLLERS.



CAUTION

INSURE FORWARD SIDE MOUNT CLEARS WHEN ROLLING ENGINE BACK; USE EXTREME CARE TO AVOID CONTACT WITH ENGINE PARTS AND PROTRUSIONS ON THE AIRCRAFT TO PRECLUDE DAMAGE TO ITEMS SUCH AS OIL TANK, OIL COOLER, BLC DUCT AND AB SECONDARY OUTER FLAP.

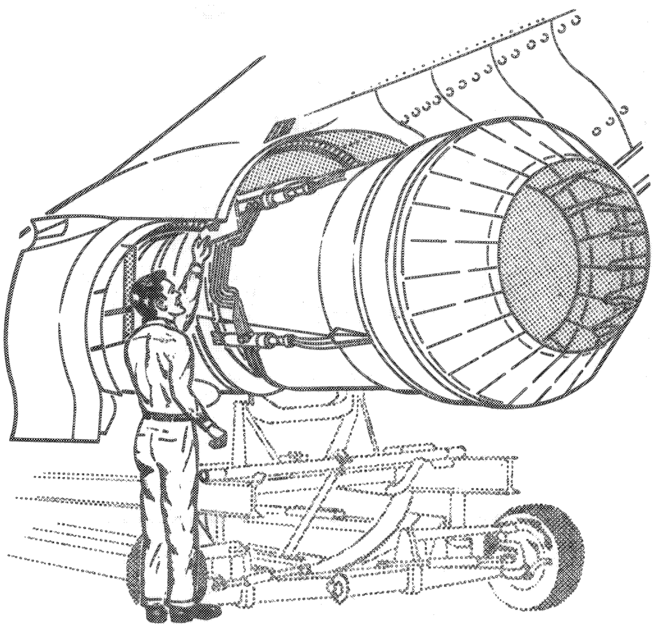
12. DISCONNECT MAIN MOUNT AND REMOVE MAIN MOUNT PIN FROM ENGINE.

4C-2-8-(76-2)A

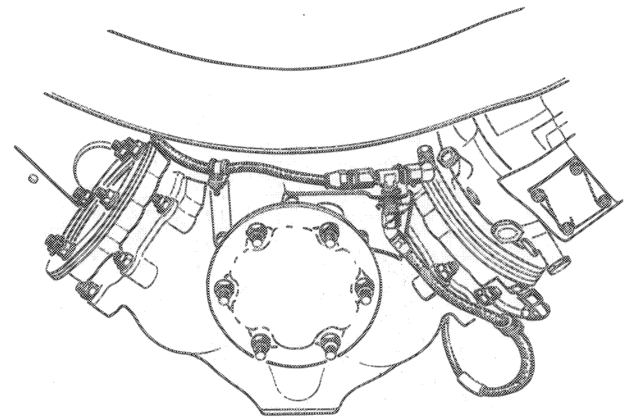
Figure 13-13. Engine Removal (Sheet 2 of 6)

CAUTION

WHEN LOWERING ENGINE AND ROLLING ENGINE BACK, ASSURE CSD OIL INLET AND OUTLET LINES CLEAR AIRCRAFT STRUCTURE TO PREVENT LINE DAMAGE.



13. LOWER ENGINE SLOWLY TO MAINTAIN CLEARANCE BETWEEN ENGINE AND FINGER SEALS.



WARNING

PRIOR TO ROLLING ENGINE BACK ENSURE THAT TRACK STOP BOLT IS IN PLACE. FAILURE TO ENSURE THE STOP BOLT IS IN PLACE COULD RESULT IN PERSONNEL INJURY OR LOSS OF LIFE.

CAUTION

WHEN MOVING ENGINE AFT, ENSURE LOW PRESSURE FUEL FILTER DOES NOT CONTACT DROPOUT LINK ATTACH POINT. DAMAGE TO FUEL FILTER COULDRESULT.

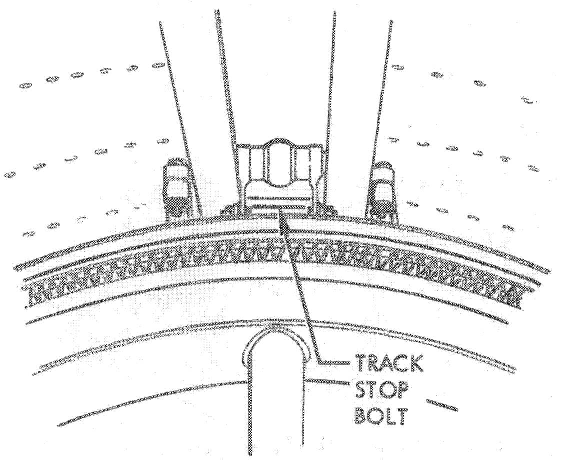
INSURE FORWARD SIDE MOUNT CLEARS WHEN ROLLING ENGINE BACK; USE EXTREME CARE TO AVOID CONTACT BETWEEN ENGINE PARTS AND PROTRUSIONS ON THE AIRCRAFT TO PREVENT DAMAGE TO ITEMS SUCH AS OIL TANK, OIL COOLER, BLC DUCTS AND A/B FLAPS.

14. MOVE ENGINE AFT UNTIL HYDRAULIC PUMPS ARE JUST FORWARD OF DROPOUT LINK MOUNTS.

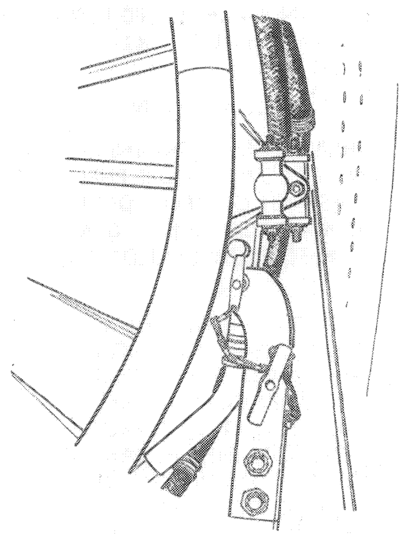
15. REMOVE HYDRAULIC PUMPS.

4C-2-8-(76-3)C

Figure 13-13. Engine Removal (Sheet 3 of 6)



16. MOVE ENGINE AND TRAILER AFT UNTIL TOP MOUNT IS A FEW INCHES FORWARD OF TRACK STOP BOLT.

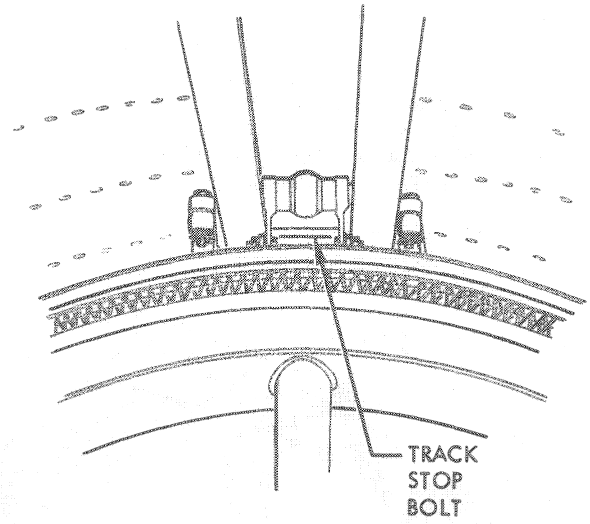


17. ATTACH FRONT CRADLE TO ENGINE FORWARD SIDE MOUNTS.

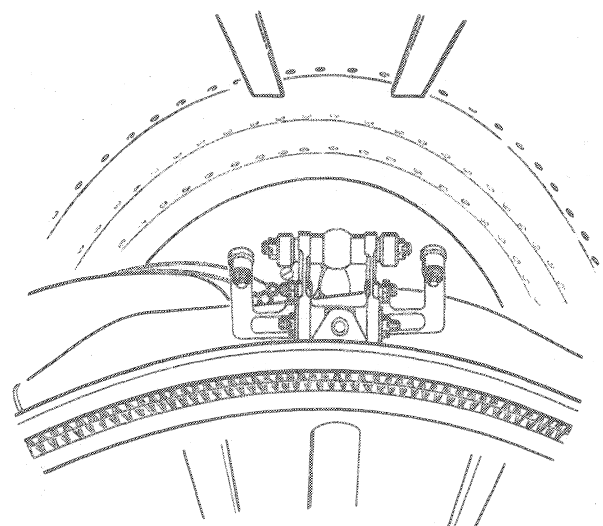
18. PUMP UP FRONT CRADLE UNTIL LOWER RING SEGMENT IS POSITIONED ON RISERS.

19. LOCK FRONT ROLLER ADAPTERS.

20. PUMP UP FORWARD END OF TRAILER ONLY ENOUGH TO UNLOAD ROLLERS FROM TRACK.



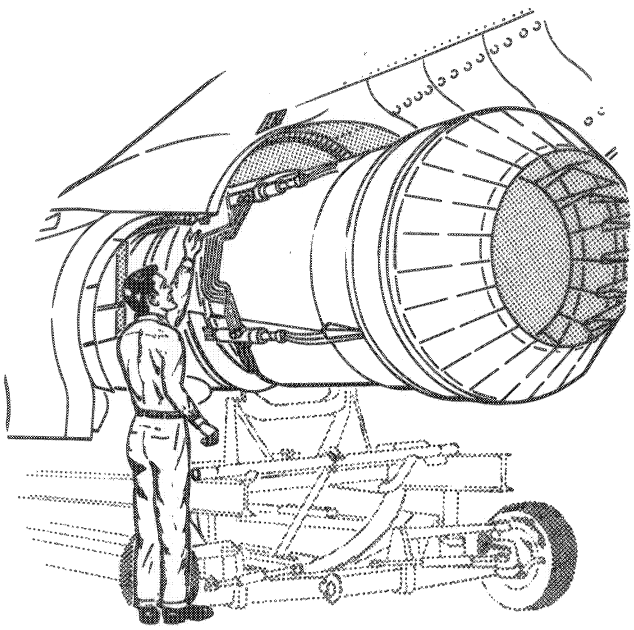
21. REMOVE TRACK STOP BOLT.



22. MOVE ENGINE MOUNT OFF TRACK AND LOWER ENGINE.

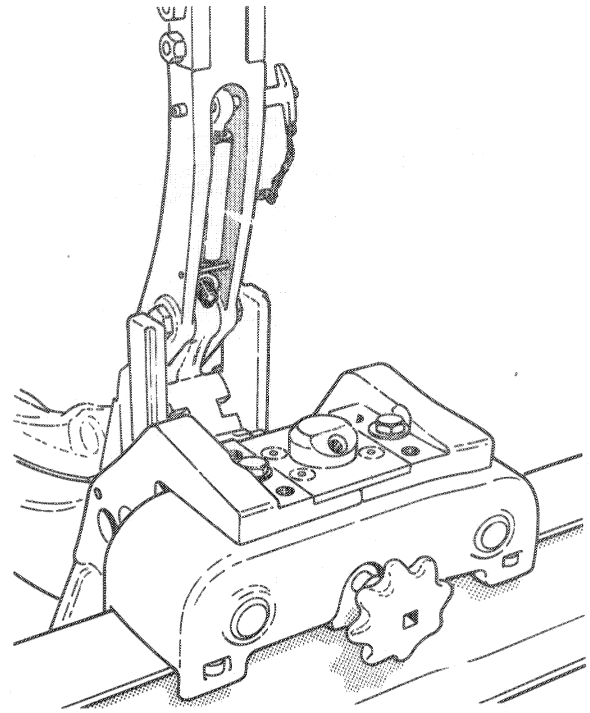
4C-2-8-(76-4)

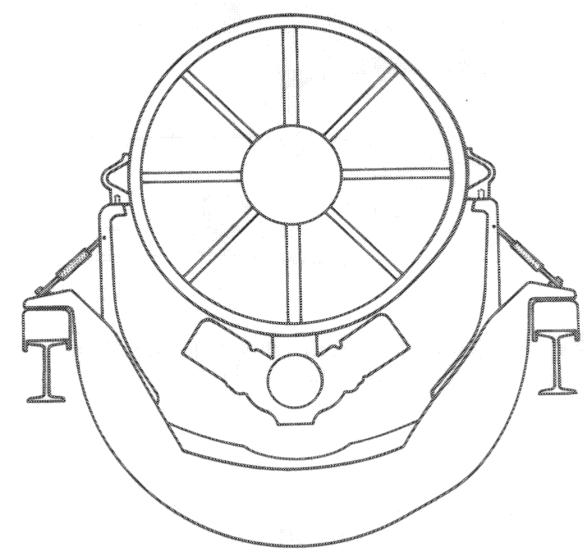
Figure 13-13. Engine Removal (Sheet 4 of 6)



NOTE
USE TWO PIECES OF METAL TO SHOE HORN ENGINE PAST FINGER SEALS IF CLEARANCE PROBLEM ARISES.

23. MOVE ENGINE AFT FROM COMPARTMENT.



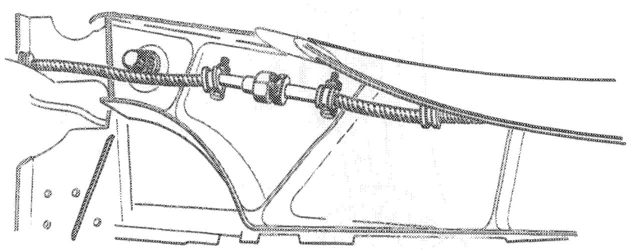


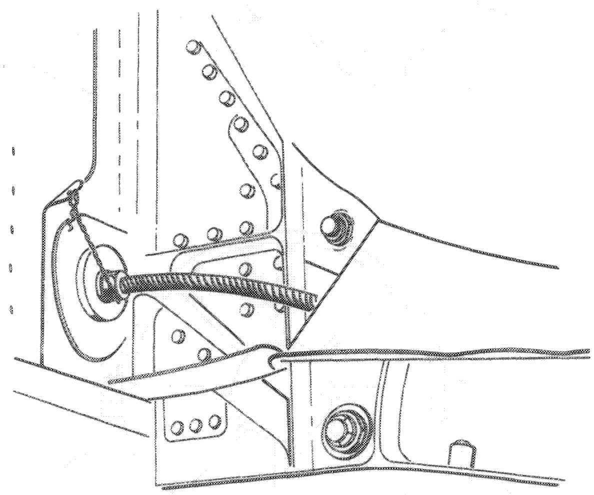
24. LOWER ENGINE FROM INSTALLATION RISERS.

25. INSTALL TRANSPORTATION BRACES ON FORWARD CRADLE AND INSTALL PINS IN FORWARD SIDE MOUNTS.

4C-2-8-(76-5)

Figure 13-13. Engine Removal (Sheet 5 of 6)





26. REINSTALL DROPOUT LINK WITH BOLTS AND BUSHINGS ; TIGHTEN NUTS.

27. CONNECT AILERON TRIM FLEX SHAFT AT INBOARD AND OUTBOARD ENDS OF DROPOUT LINK.

28. DO NOT CONNECT AILERON TRIM ELECTRICAL CONNECTOR.

29. UNTIE AND LOWER MAIN LANDING GEAR DOOR.

4C-2-8-(76-6)

Figure 13-13. Engine Removal (Sheet 6 of 6)

l. Pull LH and RH EGT circuit breaker.

m. Open door 22.

n. Open engine access doors. See figure 13-10.

o. Disconnect engine. See figures 13-11 and 13-12.

p. Remove engine. See figure 13-13.

q. Roll back engine. See figure 13-13 steps 1 thru 19.

13-44. Mount Inspection.

13-45. Main Mount.

a. Clean main mount pin with solvent.

b. Visually inspect pin for evidence of galling and corrosion.

c. Use micrometer to check pin for engine mount bearing diameter of 1.2470 to 1.2492 inches. Send galled, corroded or excessively worn pins to next higher maintenance level for disposition or rework.

CAUTION

De-burr bolt roll pin hole before installing new nut. Possible damage will occur if not complied with.

d. Check main engine mount nuts running torque. Replace nuts having a running torque of less than 24 inch-pounds.

13-46. Forward Top Mount.

CAUTION

Do not lubricate acme thread bolt or barrel nut installed in mount assembly.

a. Visually inspect bolt for evidence of galling, compare load carrying middle portion of thread length to end portion.

b. BEFORE TO 1F-4-991, NDI bolt for cracks.

c. Inspect bolt for application and condition of dry film lubricant.

13-47. Compartment Preparation.

a. Perform engine compartment inspection. Refer to section XIV.

a1. Visually inspect all available pseudo and rear signal cables and connectors for damage and security and perform TS—2059/AWM—18 check per applicable publication prior to power plant reinstallation.

b. Ensure engine compartment fire detector sensing elements and connectors are cleaned per T.O.1F—4C—2—13 and are in good condition and all fasteners secured.

c. Perform fire detector resistance check. Perform fire detector and aft fuselage overheat detector functional test on each element.

d. Ensure fire detector flexible conduit forms a loop away from hinge when doors 83 and 92 are closed.

e. Open all engine access doors.

f. Remove drop out link.

g. Remove track stop bolt.

h. Open main mount jaw and remove pin.

i. Open forward top mount jaw so inside of jaw is level with inside of rail track.

j. Vacuum clean engine, inlet air duct, and engine bay. Perform FOD prevention inspection.

k. Lubricate contact area of aft fuselage finger seals with MIL—L—25681.

13-48. Installation.

a. Install Roll Back Engine. See figure 13—14, steps 10 thru 26.

b. Connect engine. See figures 13—11 and 13—15.

c. Perform cartridge start system checkout. Refer to TO 1F-4C-6WC-4.

d. Perform engine prestart and check for leaks. Refer to section II.

e. Start engine. Refer to section II.

f. Perform post installation runup. Refer to section II.

g. Perform lateral control system operation check. Refer to TO 1F-4C-2-4.

h. With engine operating, check for bleed air leakage around ducts. Use hand feel method.

i. Shut down engine.

j. Close engine access doors. See figure 13— 16.

13-49. FORWARD TOP MOUNT REPLACEMENT — BEFORE T O 1F—4—991.

13-50. Tools and Equipment.

Wrench, torque, 0 to 150 inch—pounds
Wrench, torque, 100 to 750 inch—pounds

13-51. Materials.

Pin, cotter, MS24665—283

13-52. Removal. See figure 13—17.

a. Roll engine back. Refer to paragraph 13—39.

b. Inside engine compartment, remove nut from bolt (1).

c. Through door 40L or R, turn bolt (1) counterclockwise until free from mount. Remove bolt.

d. Remove bolts (7), (2), (3), and remove mount.

e. Retain shims for reinstallation.

13-53. Installation. See figure 13–17.

NOTE

Mount, fitting and jaw have matched numbers stamped or engraved on facing surfaces of aft lips. The mount must be installed as a matched assembly.

Install longer bolts (2) on inboard side of bolt (1).

a. Place shims on mount, position mount on structure and secure with bolts (2), (7) and (3). *Torque bolts (2) 20 to 25 inch–pounds. Torque bolts (7) 50 to 70 inch–pounds. Torque bolts (3) 160 to 190 inch–pounds.*

NOTE

If bolts do not have proper protrusion, next size longer bolts may be substituted. If bolt bottoms in nut add washer under bolt head.

b. *Ensure bolts (3) have proper protrusion through nuts and do not bottom.*

CAUTION

Ensure upper forward mount tension bolt passes through trunnion spacer during installation of bolt. Visually inspect through doors 41L/41R for proper installation.

c. *Turn bolt (1) into barrel nut until retaining nut and cotter pin can be installed.*

d. Install engine. See figure 13-14. If 0.030 inch minimum clearance between bottom of track and top of yoke does not exist, add additional laminated shims under top forward mount.

13-53A. FORWARD TOP MOUNT REPLACEMENT — AFTER T.O.1F-4-991.

13-53B. Tools and Equipment.

Wrench, torque, 0 to 150 inch-pounds
Wrench, torque, 100 to 750 inch-pounds

13-53C. Materials.

Pin, cotter, MS24665-283
Pin, cotter, MS24665-136
Pin, cotter, MS24665-357
Lockwire, MS20995NC40

13-53D. Removal. See figure 13-17.

a. Roll engine back. Refer to paragraph 13-39.

b. Inside engine compartment, remove cotter pin and nut (5).

c. Remove cotter pin, nut, and stop bolt (6).

d. Remove cotter pin, nut, jawbolt (4), and jaw.

e. Inside engine compartment, remove compression bolt (1) from mount.

f. Remove bolts (7), (2), (3) and remove mount.

NOTE

Retain shims for reinstallation.

13-53E. Installation. See figure 13-17.

NOTE

Mount, fitting and jaw have matched numbers stamped or engraved on facing surfaces of aft lips. The mount must be installed as a matched assembly.

a. Place shims on mount. Position mount on structure and secure with bolts (2), (7), and (3). *Torque bolts (2) 20 to 25 inch-pounds. Torque bolts (7) 50 to 70 inch-pounds. Torque bolts (3) 475 to 525 inch-pounds.*

NOTE

If bolts do not have proper protrusion, next size longer bolts may be substituted. If bolt bottoms in nut, add washer under bolt head.

b. *Assure bolts (3) have proper protrusion through nuts and do not bottom.*

CAUTION

Assure upper forward mount compression bolt passes through trunnion spacer during installation of bolt. Visually inspect through doors 41L/41R for proper installation.

c. Inside engine compartment, turn compression bolt (1) into mount until nut (5) and cotter pin can be installed.

d. Install jaw, jawbolt, and nut (4).

e. Install stop bolt and nut (6).

f. Install nut and cotter pin (5).

g. Install engine. See figure 13-14. If 0.030 inch minimum clearance between bottom of track and top of yolk does not exsist, add additional laminated shims under top forward mount.

13-54. FORWARD SIDE MOUNT REPLACEMENT.

13-55. Tools and Equipment.

Wrench, torque, 0 to 150 inch-pounds

13-56. Materials.

Pin, cotter, MS24665-153

13-57. Removal. See figure 13-17.

NOTE

Forward side mount may be replaced without removing engine.

a. Through door 42 L or R and panel 132 L or R, open mount jaw and swing engine mounted universal forward.

b. Remove nuts and bolts (14) and remove mount.

NOTE

It may be necessary to remove eyebolt retaining bolt to remove bottom outboard mount bolt.

13-58. Installation. See figure 13-17.

NOTE

It may be necessary to remove eyebolt retaining bolt to install bottom outboard mount bolt.

a. *If eyebolt retaining bolt was removed, reinstall and torque bolt 50 to 70 inch-pounds. Install cotter pin.*

b. *Secure mount to structure. Torque bolts (14) 50 to 70 inch-pounds.*

c. *Swing engine mounted universal into position and close mount jaw. Torque eyebolt nut 80 to 100 inch-pounds.*

d. *Install panel 132 L or R and close door 42 L or R.*

1. ZERO ALL TRAILER CONTROLS.

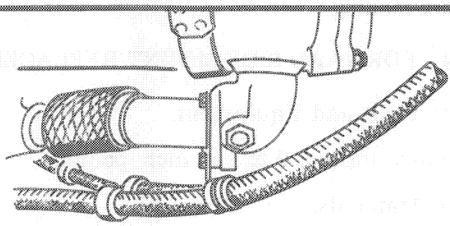
a. REMOVE TRANSPORTATION BRACES.

b. RAISE ENGINE UP USING INSTALLATION RISERS.

c. REMOVE PINS FROM FORWARD SIDE MOUNTS.

2. TIE FORWARD DRAIN LINES TO ENGINE.

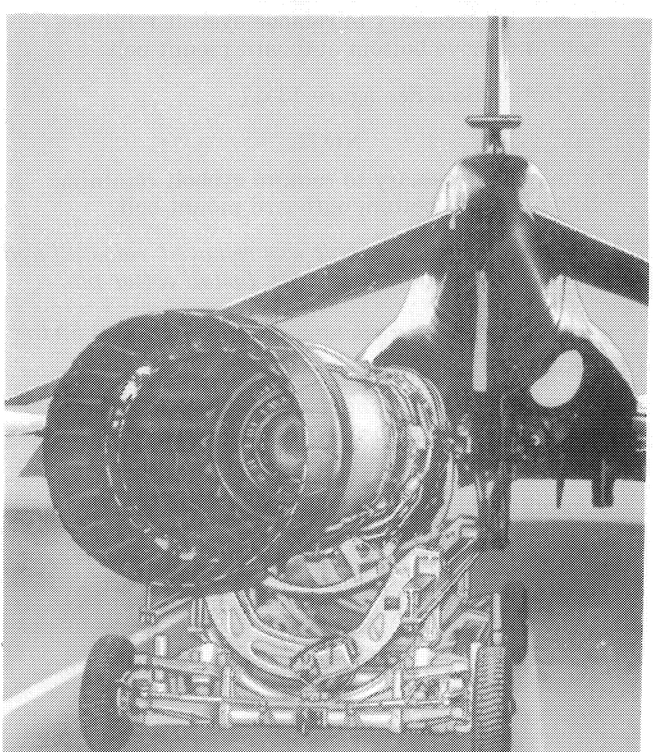
3. REMOVE HYDRAULIC PUMPS



4. LOOSEN CLAMPS ON CSD INLET AND OUTLET LINES AT FUEL INLET MANIFOLD BRACKET AND MOVE LINES TO GAIN CLEARANCE FOR INSTALLATION.

NOTE

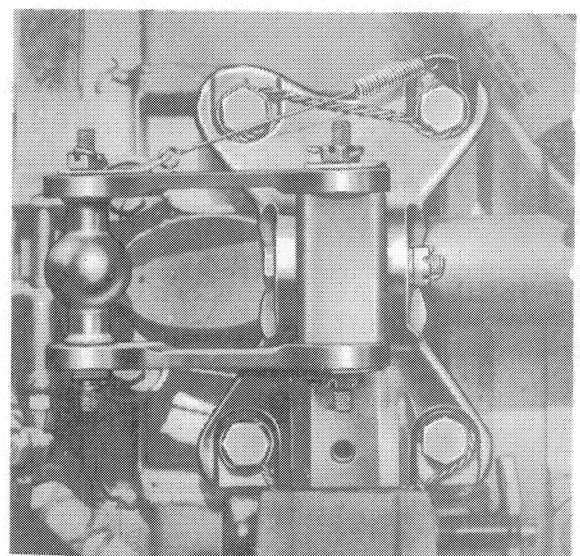
ASSURE MAIN LANDING GEAR DOOR IS TIED UP BEFORE ROLLING ENGINE INTO CAVITY TO ALLOW CLEARANCE BETWEEN MLG DOOR AND ENGINE STAND.



PP-80

5. CENTER ENGINE WITH VERTICAL CENTER LINE OF ENGINE COMPARTMENT.

6. MOVE ENGINE FORWARD INTO COMPARTMENT UNTIL FRONT OF ENGINE IS IN LINE WITH KEEL BLEED AIR DUCT.



E-151

NOTE

ASSURE FORWARD SIDE MOUNT BALL IS FORWARD PRIOR TO RAISING ENGINE INTO CAVITY.

CAUTION

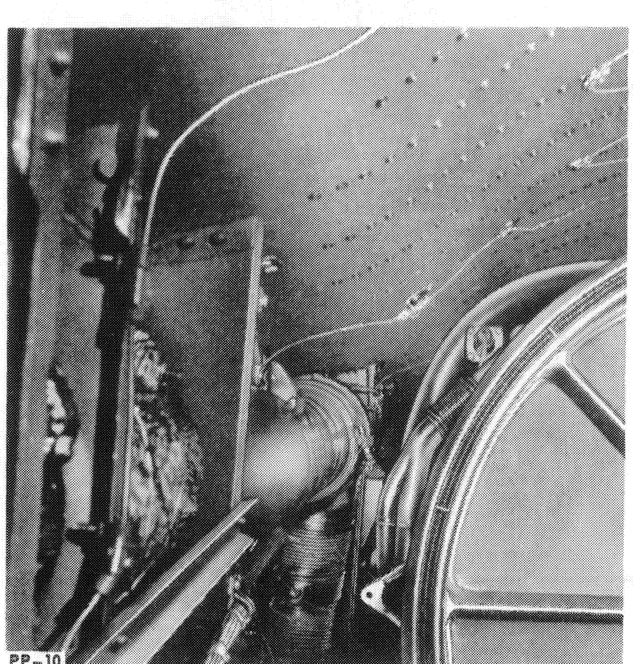
DURING ENGINE INSTALLATION, MAINTAIN CLEARANCE BETWEEN ENGINE OIL TANK AND UPPER TANGENTIAL BRACE

TO AVOID DAMAGE TO ENGINE OR AIRCRAFT, OBSERVE FOLLOWING INTERFERENCE POINTS:

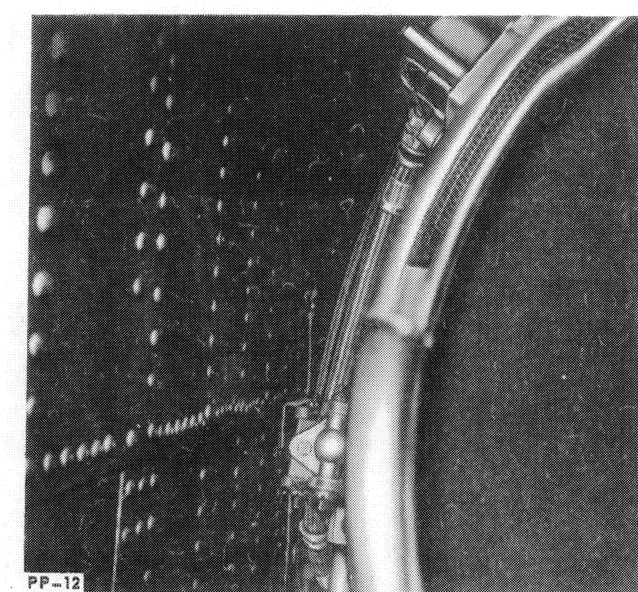
a. DOOR 83 L OR R

4C-2-8-(77-1)

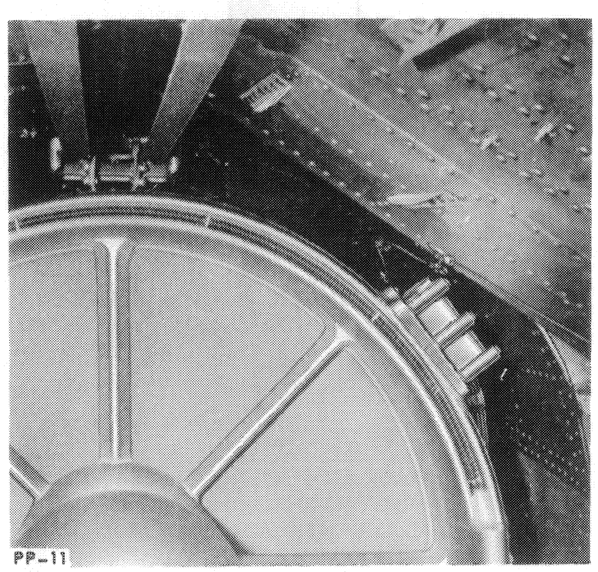
Figure 13-14. Engine Installation (Sheet 1 of 6)



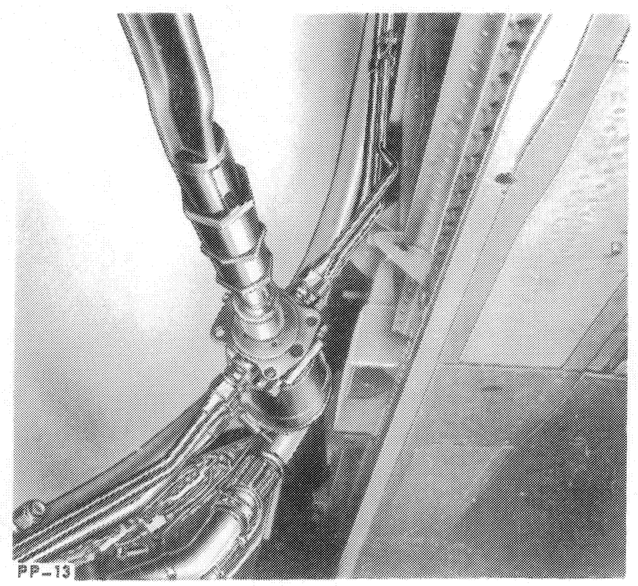
b. LEFT ENGINE FRONT INBOARD MOUNT AND KEEL.



d. FRONT OUTBOARD MOUNT AND FIRE DETECTOR CONDUIT.



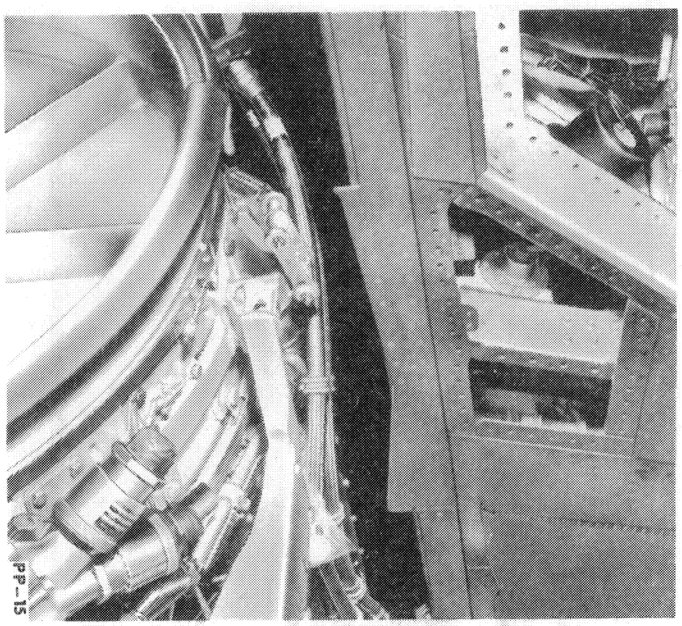
c. AIR OIL COOLER VALVE AND FIRE DETECTOR CONDUIT.



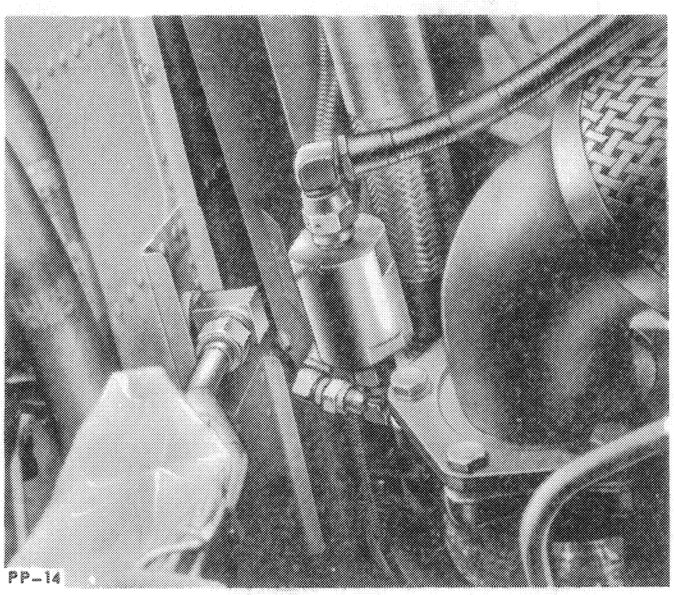
e. NOZZLE ACTUATOR LINES AND AFT KEEL STRUCTURE.

4C—2—8—(77—2)

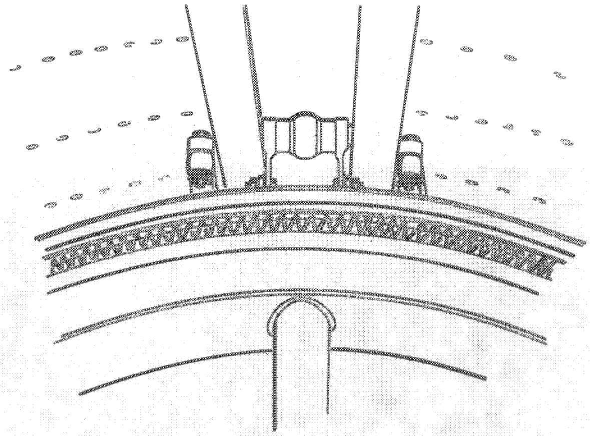
Figure 13-14. Engine Installation (Sheet 2 of 6)



f. AIR COOLER LINES AND STRUCTURE.



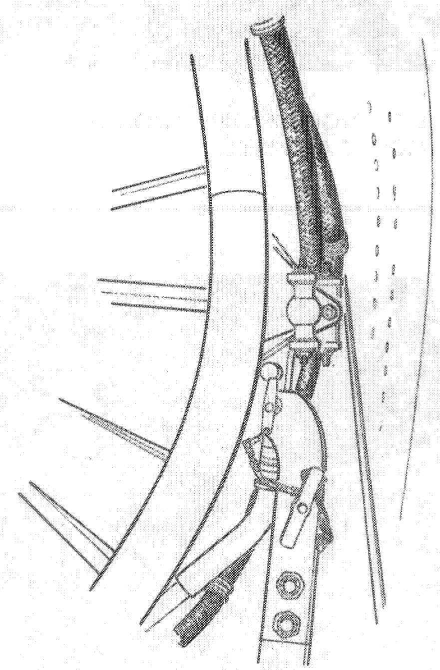
g. LEFT ENGINE TEMPERATURE AMPLIFIER COOLING FUEL LINE AND HYDRAULIC LINE.



7. RAISE FRONT OF ENGINE UNTIL SKATE MOUNT IS IN LINE WITH TRACK.

8. MOVE ENGINE FORWARD.

9. INSTALL TRACK STOP BOLT. TORQUE NUT 50-70 INCH POUNDS OR UNTIL SPACER IS SNUG BETWEEN FLANGES.



WARNING

ENSURE TRACK STOP BOLT IS INSTALLED PRIOR TO REMOVING FRONT TRAILER ADAPTER AND ADAPTER SUPPORT BARS. FAILURE TO INSTALL TRACK STOP BOLT COULD RESULT IN PERSONNEL INJURY OR LOSS OF LIFE.

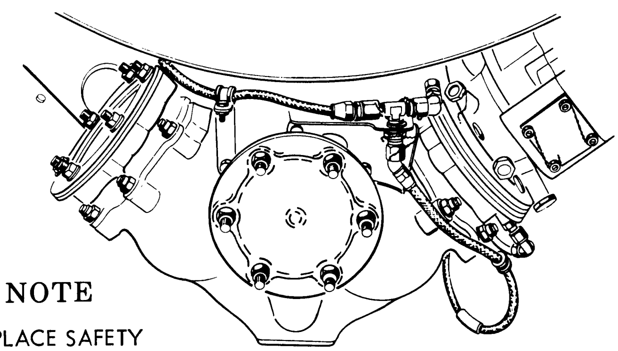
10. REMOVE FORWARD TRAILER ADAPTER AND ADAPTER SUPPORT BARS.

4C-2-8-(77-3)E

Figure 13-14. Engine Installation (Sheet 3 of 6)

11. MOVE ENGINE FORWARD. RAISE AFT END OF ENGINE WHEN AFTERBURNER NOZZLE ACTUATORS ARE FORWARD OF FINGER SEALS.

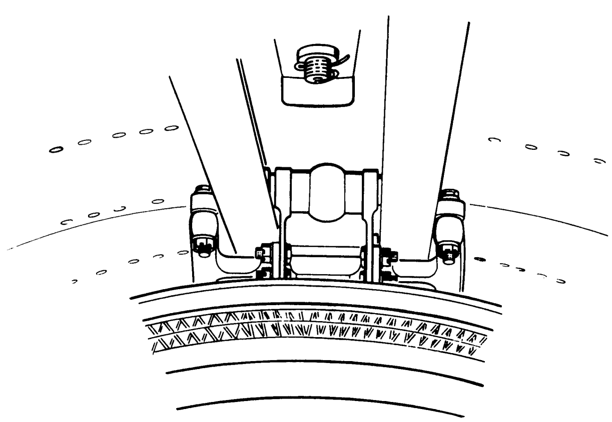
12. MOVE ENGINE FORWARD UNTIL TRANSFER GEAR BOX IS LOCATED JUST FORWARD OF DROPOUT LINK ATTACH POINTS.



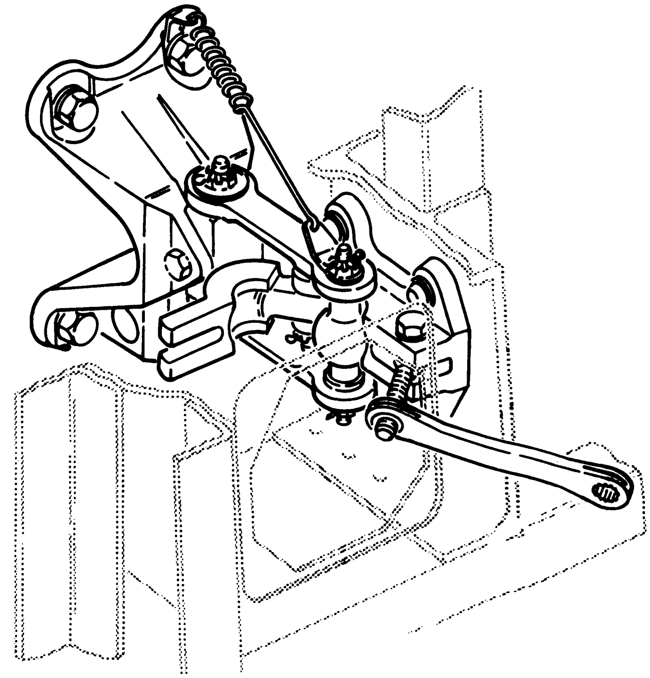
NOTE

REPLACE SAFETY NUT EACH TIME COUPLING IS UNLATCHED.

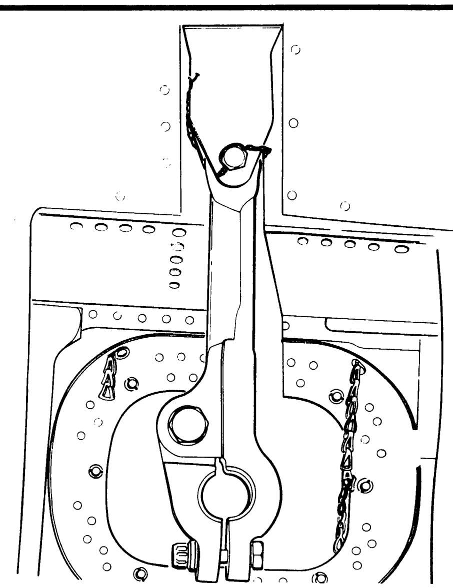
13. INSTALL HYDRAULIC PUMPS. INSTALL SELF-LOCKING NUT AND TORQUE COUPLING 45 TO 55 INCH-POUNDS. INSTALL SAFETY NUT AND TORQUE 45 TO 55 INCH-POUNDS.



14. MOVE ENGINE FORWARD UNTIL FORWARD SIDE ENGINE MOUNT CONTACTS THE AIRCRAFT MOUNT.



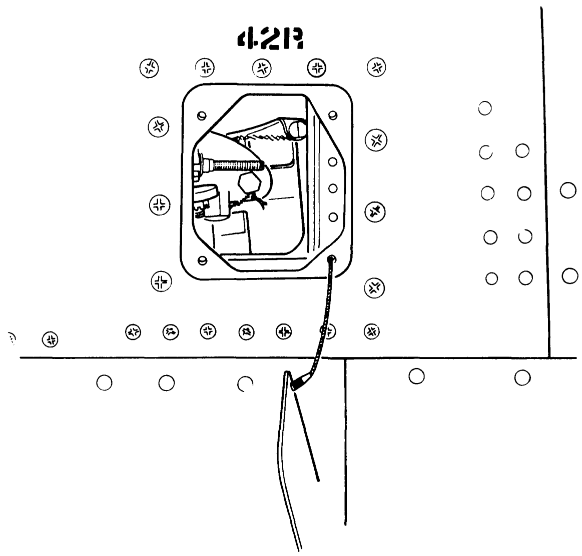
15. OPEN AIRFRAME FORWARD SIDE MOUNT AND GUIDE BALL INTO MOUNT AS ENGINE IS MOVED FORWARD.



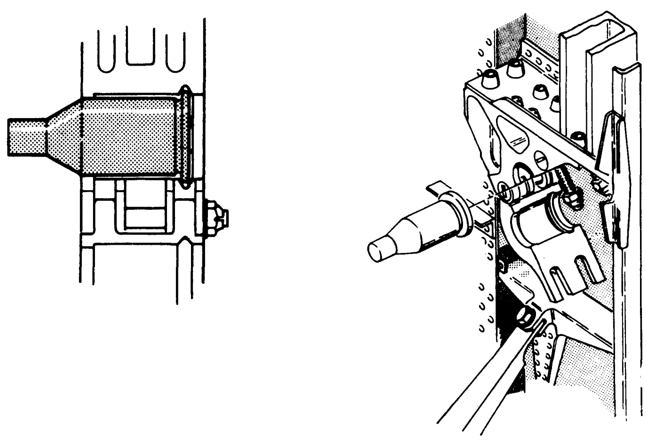
16. CENTER UPPER TANGENTIAL BRACE AFTER OIL TANK IS CLEAR.

4C-2-8-(77-4)

Figure 13-14. Engine Installation (Sheet 4 of 6)



17. CLOSE AND TORQUE FORWARD SIDE MOUNT 80 to 100 INCH-POUNDS.

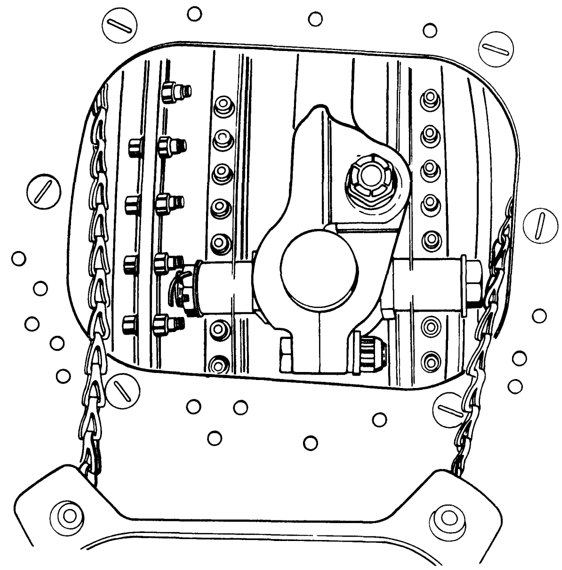


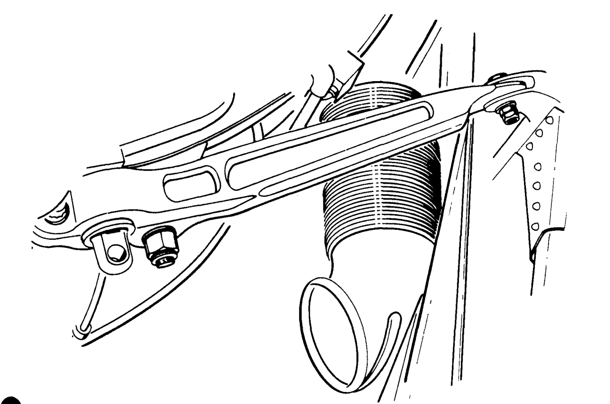
NOTE

APPLICATION OF MAGNESIUM OXIDE (MILK OF MAGNESIA) TO THAT PORTION OF MAIN MOUNT PIN INSERTED INTO ENGINE UNIBAL WILL ALLEVIATE PIN SEIZURE.

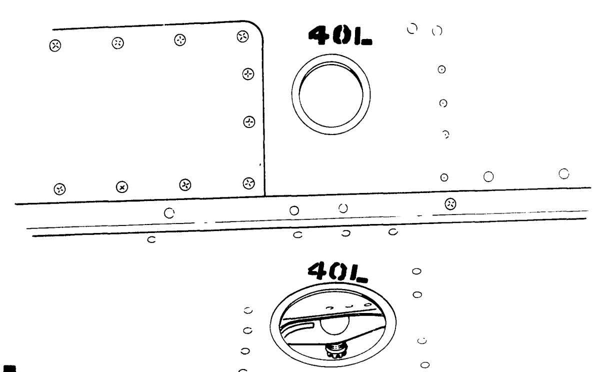
18. INSTALL ENGINE MAIN MOUNT PIN IN UNIBALL AND POSITION PIN IN GROOVE OF MAIN MOUNT JAW.

19. CLOSE AND TORQUE MAIN MOUNT 900 TO 1000 INCH-POUNDS. LOCKWIRE NUTS WITH MS20995NC32.





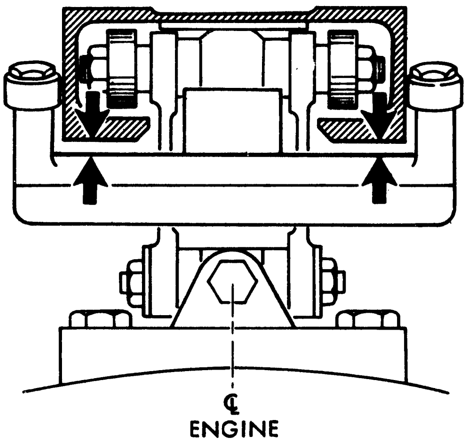
20. CONNECT UPPER AND LOWER TANGENTIAL BRACES. TORQUE BOLT AT ENGINE CONNECTION 1000 TO 1100 INCH-POUNDS. TORQUE BOLT AT AIRFRAME CONNECTION 450 TO 500 INCH-POUNDS. ASSURE A 0.001 TO 0.005 INCH GAP EXISTS BETWEEN THE PIVOT BOLT WASHER AND THE LUG FACE.



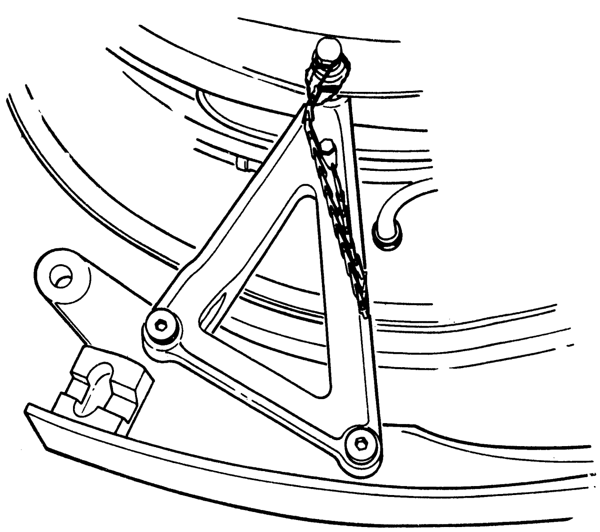
21. ASSURE BALL OF FORWARD TOP MOUNT IS IMPEDDED IN JAW SOCKET. TORQUE TOP MOUNT BOLT 600 TO 800 INCH POUNDS (BALL SHOULD BE DRAWN FIRMLY AGAINST UPPER MOUNT JAW). LOCKWIRE BOLT WITH MS20995NC41.

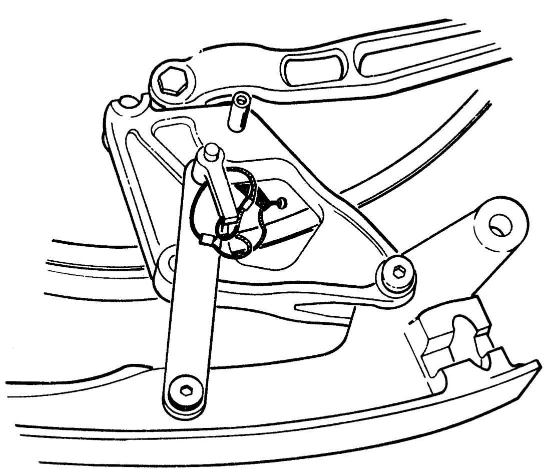
4C-2-8-(77-5)D

Figure 13-14. Engine Installation (Sheet 5 of 6)



22. ● ASSURE 0.030 INCH MINIMUM GAP EXISTS BETWEEN BOTTOM OF TRACK AND TOP OF YOKE. IF CLEARANCE DOES NOT EXIST REFER TO FORWARD TOP MOUNT REPLACEMENT.

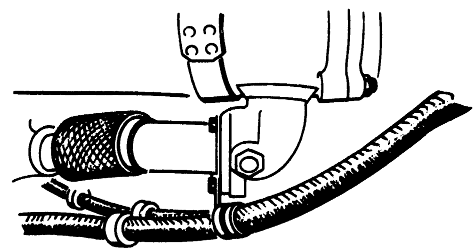




23 ● DISENGAGE REAR SUPPORTS AND LOWER CRADLE.

24. MOVE TRAILER OUT OF ENGINE COMPARTMENT.

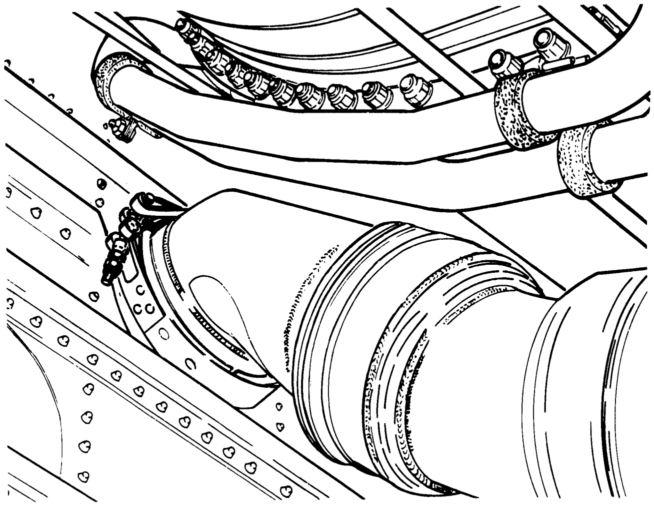
25. UNTIE AND LOWER MAIN LANDING GEAR DOOR.

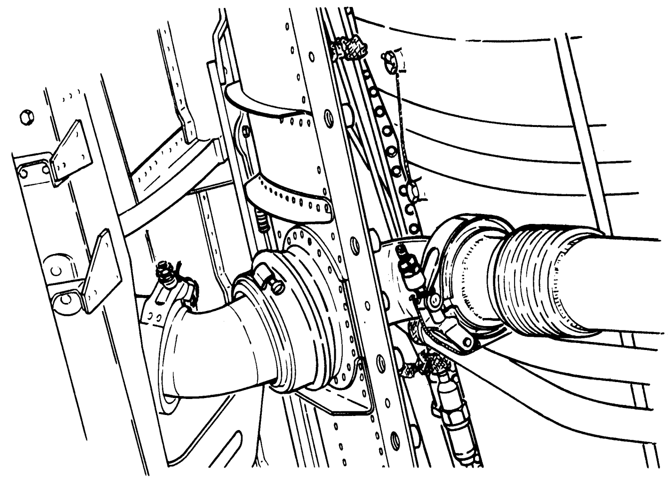


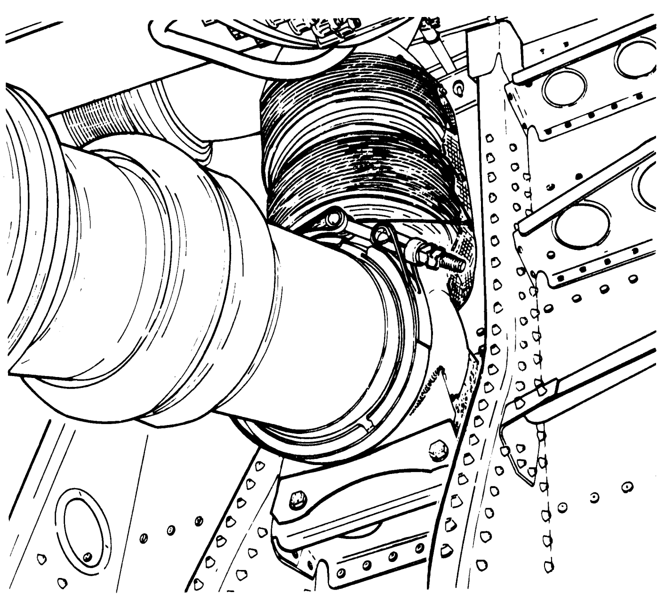
26. REPOSITION CSD INLET AND OUTLET LINES AT FUEL INLET MANIFOLD BRACKET.
REFER TO T.O. 1F-4C-10.

4C—2—8—(77—6)C

Figure 13-14. Engine Installation (Sheet 6 of 6)



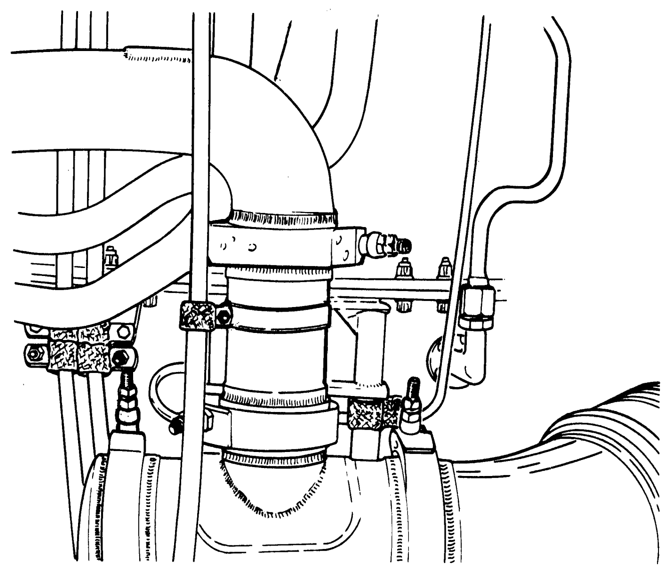




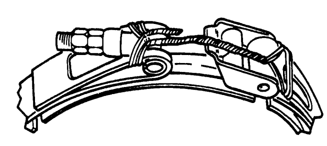
NOTE

REPLACE SAFETY NUT EACH TIME COUPLING IS UNLATCHED.

1. CONNECT MAIN BLEED AIR DUCT. TORQUE COUPLING LOCKNUTS AND SAFETY NUTS 120 TO 140 INCH-POUNDS.



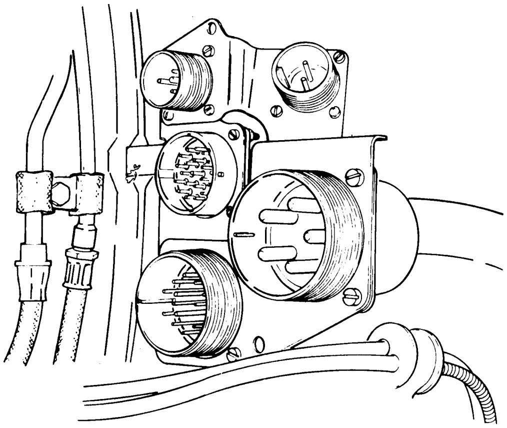
2. INSTALL REMOVABLE SHROUD.

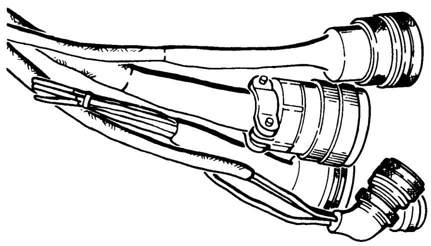


3. CONNECT TRAILING EDGE BLEED AIR DUCT. TORQUE COUPLING LOCKNUTS AND SAFETY NUTS 75 TO 80 INCH-POUNDS. LOCKWIRE COUPLINGS WITH TWO STRANDS OF MS20995NC41.

4C-2-8-(169-1)

Figure 13-15. Engine Connection (Sheet 1 of 8)



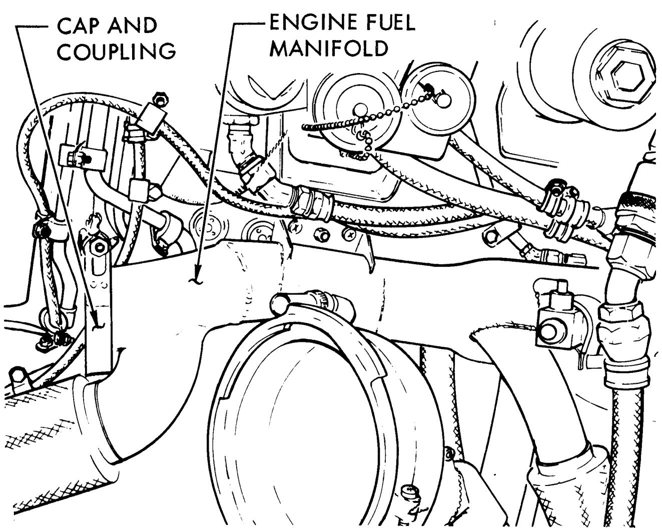


CAUTION

ASSURE CHAFING CONDITIONS DO NOT EXIST. WIRE BUNDLES, ENGINE AND ENGINE BAY COMPONENTS ARE SUSCEPTIBLE TO CHAFING BECAUSE OF FLEXIBILITY AND CONGESTION.

4. CONNECT ENGINE ELECTRICAL CONNECTORS.

5. LOCKWIRE CONNECTORS WITH MS20995NC20.



6. DRAIN RESIDUAL FUEL AS FOLLOWS:

a. VISUALLY MAKE SURE ENGINE FUEL SHUTOFF VALVE INDICATOR IN DOOR 22 READS CLOSED. IF VALVE INDICATOR READS OPEN, PERFORM STEPS f THRU k OF PARAGRAPH 13-43.

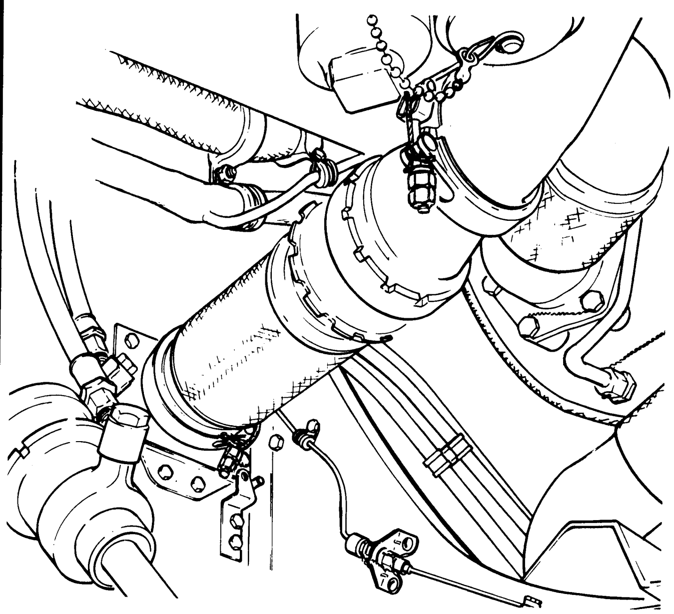
b. OPEN DRAIN VALVE ON ENGINE FUEL FEED LINE DOWNSTREAM FROM SHUTOFF VALVE IN DOOR 22 AND DRAIN ALL FUEL FROM FEED LINE INTO A SUITABLE CONTAINER.

WARNING

RESIDUAL FUEL MAY BE PRESENT BEHIND CAP. TO PREVENT THE POSSIBLITY OF FIRE, COLLECT DRAIN FUEL IN SUITABLE CONTAINER.

c. REMOVE CLAMP AND CAP FROM KEEL FUEL FLANGE.

7. INSTALL CAP AND COUPLING ON ENGINE FUEL MANIFOLD. TORQUE LOCKNUT AND SAFETY NUT 60 TO 80 INCH-POUNDS. LOCKWIRE COUPLING WITH TWO STRANDS OF MS20995NC41.



NOTE

INSTALL INLET FUEL DISCONNECT WITH ADJUSTMENT NUT NEXT TO ENGINE MANIFOLD.

8. INSTALL INLET FUEL DISCONNECT.

a. REMOVE BOLTS FROM PRELOADING FLANGE.

b. MOVE FLANGE AFT TO ENGAGE DOWEL IN SPRING CLIP.

NOTE

IF FLANGES ALIGN CORRECTLY WITHOUT DISTURBING PREVIOUS ADJUSTMENT NUT SETTING, SUBSEQUENT RETORQUING AND LOCKWIRING IS NOT REQUIRED.

4C-2-8-(169-2)L

Figure 13-15. Engine Connection (Sheet 2 of 8)

c. POSITION DISCONNECT ASSEMBLY WITH SEALS AND, IF NECESSARY, ADJUST FLANGES TO MEET BUT NOT DEFLECT BELLOWS.

d. INSTALL BOTH COUPLINGS. TORQUE OUTBOARD COUPLING LOCKNUT AND SAFETY NUT 60 TO 80 INCH-POUNDS.

CAUTION

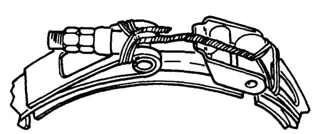
ASSURE THAT COUPLING NUT ON KEEL END OF FUEL DISCONNECT ON LEFT ENGINE IS POSITIONED ON THE SIDE OPPOSITE AUXILIARY AIR DOOR CYLINDER TO PREVENT CHAFING.

e. TORQUE ADJUSTMENT NUT 708 TO 744 INCH-POUNDS. SECURE NUT WITH MS20995NC41. LOCKWIRE.

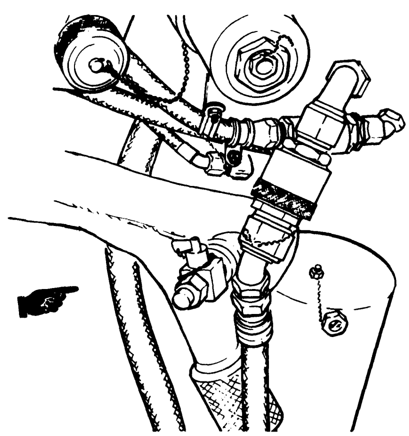
f. DISENGAGE DOWEL PIN FROM SPRING CLIP AND MOVE PRELOADING FLANGE FORWARD.

g. INSTALL AND TORQUE FLANGE BOLTS.

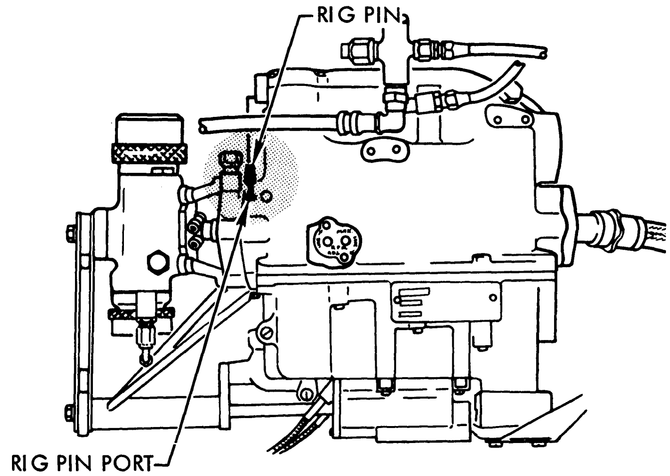
h. TORQUE INBOARD COUPLING LOCKNUT AND SAFETY NUT 60 TO 80 INCH-POUNDS.



i. LOCKWIRE BOTH COUPLINGS WITH TWO STRANDS OF MS20995NC41.



9. CLOSE FUEL DRAIN VALVE. LOCKWIRE WITH MS20995NC32.



10. CONNECT THROTTLE.

a. POSITION MAIN FUEL CONTROL AT IDLE AND INSTALL RIG PIN.

b. POSITION THROTTLE AT IDLE.

c. POSITION TORQUE BOOST INPUT SHAFT AT MIDPOINT OF ROTATIONAL PLAY.

d. CONNECT THROTTLE SHAFT TO MAIN FUEL CONTROL. TORQUE 3/16" BOLT 13 TO 15 INCH-POUNDS OR 1/4" BOLT 30 TO 40 INCH-POUNDS. INSTALL COTTER PIN.

CAUTION

ASSURE BOLTS ENGAGE UNDERCUT OF SPLINE AFTER INSTALLATION TO PREVENT THROTTLE FROM BECOMING DISCONNECTED.

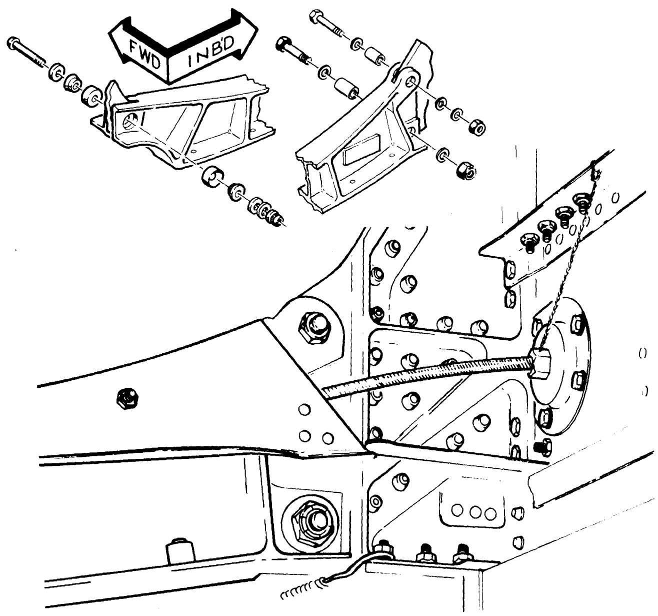
NOTES

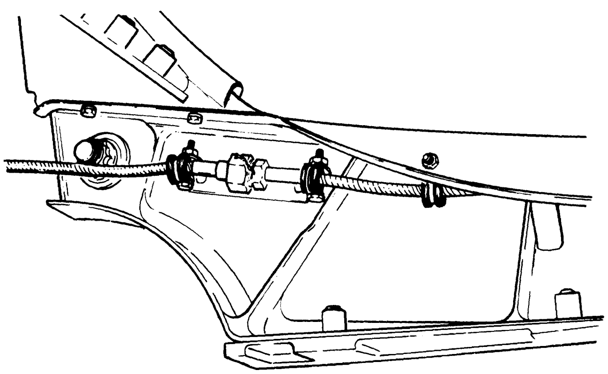
1. ASSURE THAT BOLT IS INSTALLED IN RECESSED PORTION OF SPLINED SHAFT.
2. DUE TO TOLERANCE BUILDUP, MINOR DEVIATION CONSISTING OF ADDITION OF WASHERS UNDER SUBSTITUTION OF WASHER THICKNESS OR REMOVAL OF WASHERS FROM UNDER HEAD MAY BE REQUIRED AND IS AUTHORIZED.

e. PERFORM AIRFRAME POWER PLANT CONTROL SYSTEM RIGGING CHECK. REFER TO SECTION II.

4C-2-8-(169-3)L

Figure 13-15. Engine Connection (Sheet 3 of 8)





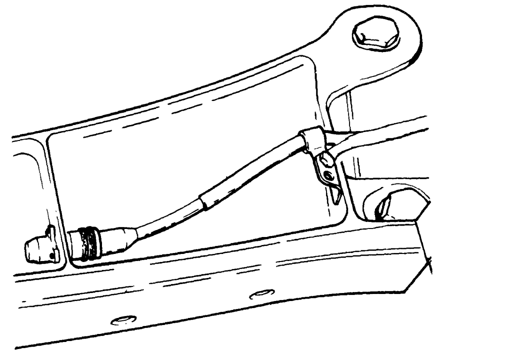
11. INSTALL DROPOUT LINK.

a. POSITION DROPOUT LINK AND INSTALL BOLTS WITH HEADS FORWARD. TORQUE UPPER INBOARD BOLT 240 TO 290 INCH-POUNDS. TORQUE LOWER INBOARD BOLT 420 TO 540 INCH-POUNDS. TORQUE OUTBOARD BOLT 2000 TO 2400 INCH-POUNDS.

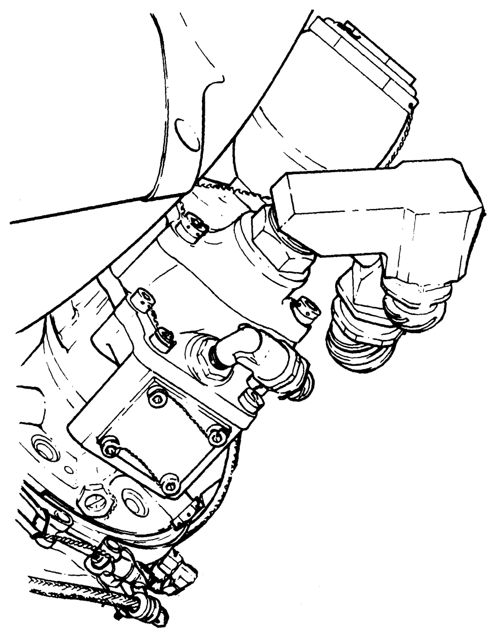
b. CONNECT AILERON TRIM FLEX SHAFT AT INBOARD AND OUTBOARD ENDS OF LINK AND CLAMP SHAFT TO LINK. TORQUE CONNECTORS 5 TO 10 INCH-POUNDS.

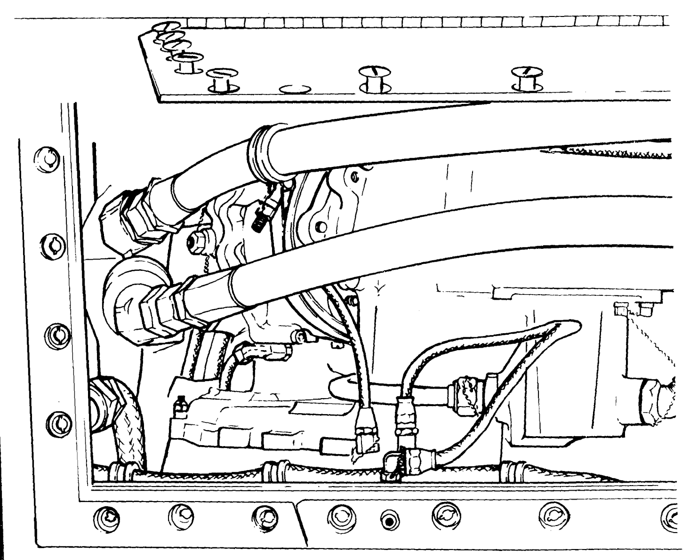
c. CONNECT AILERON TRIM ELECTRICAL CONNECTION AND CLAMP WIRE BUNDLE TO LINK.

d. LOCKWIRE CONNECTORS WITH MS20995NC32.



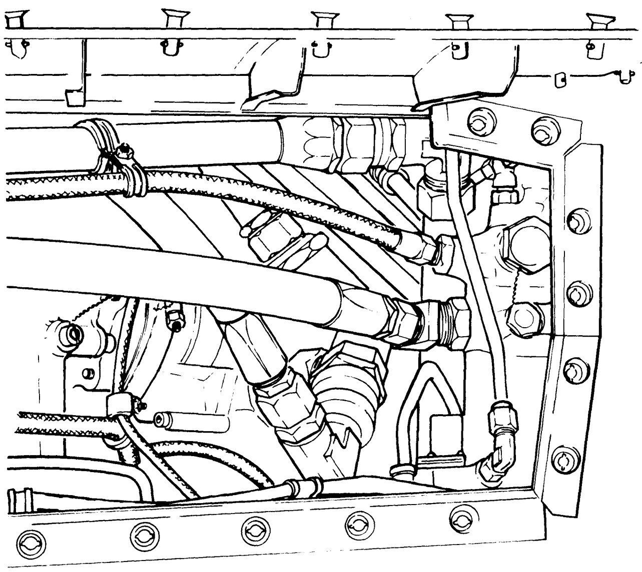
12. PERFORM LATERAL CONTROL SYSTEMS OPERATIONAL AND RIGGING CHECKOUT. REFER TO T.O. 1F-4C-2-4.





4C-2—8—(169—4)L

Figure 13-15. Engine Connection (Sheet 4 of 8)



CAUTION

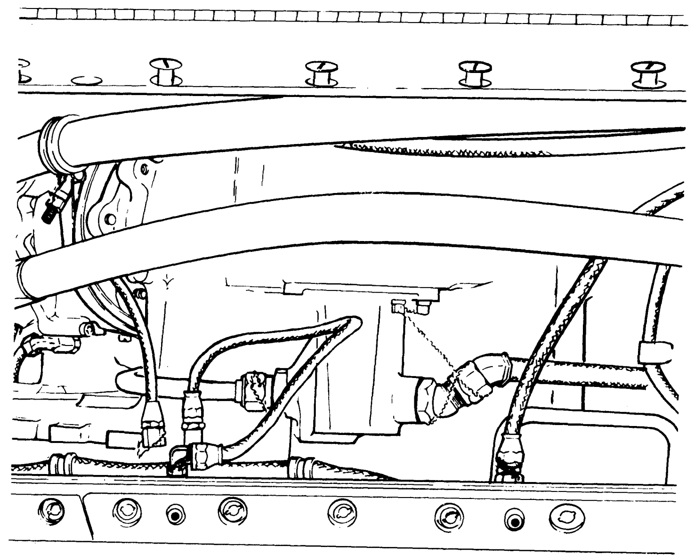
ASSURE CLAMPS ARE INSTALLED BETWEEN HYDRAULIC SUCTION LINE AND SCAVENGE LINE IN TWO PLACES OR AS REQUIRED FOR EACH HYDRAULIC PUMP. IF CLAMPS ARE NOT INSTALLED, CHAFING CAN RESULT.

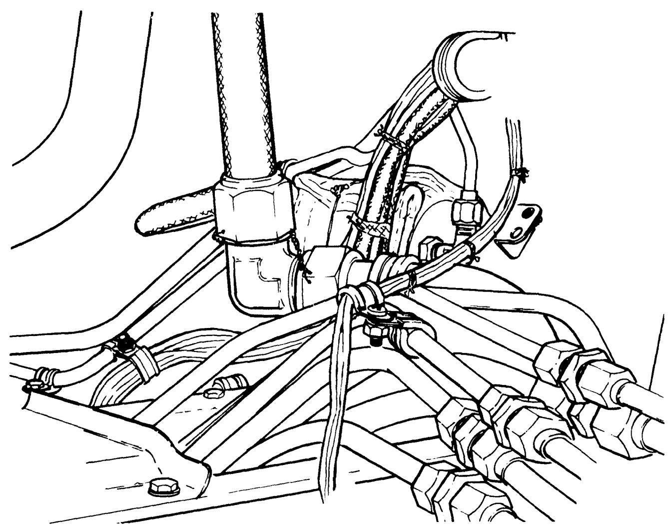
DO NOT PUSH OR PULL ON HYDRAULIC HOSES TO CHECK SECURITY. OVER TORQUED OR UNDER TORQUED PUMP FITTINGS COULD RESULT.

NOTE

HYDRAULIC HOSES CONTACTING EACH OTHER OR CONTACTING DOOR AFTER DOOR CLOSING ARE ACCEPTABLE PROVIDED CONTACT PRESSURE IS LIGHT AND CHAFE GUARDS ARE INSTALLED.

13. CONNECT QUICK DISCONNECT FITTINGS TO HYDRAULIC PUMPS.





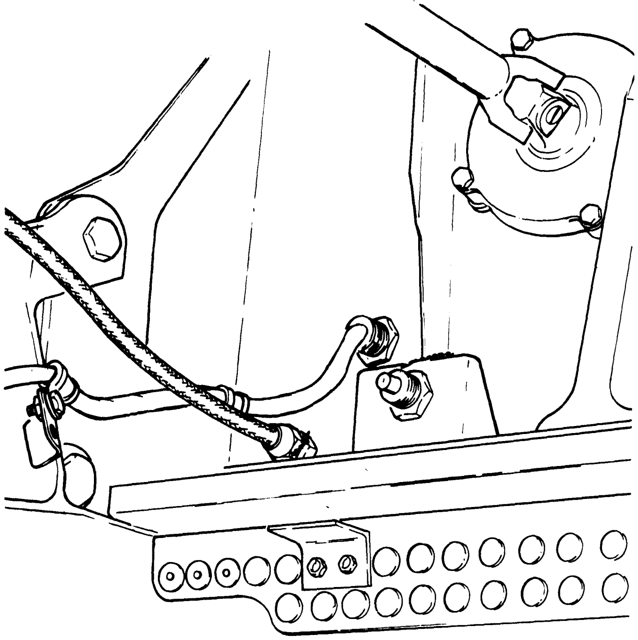
CAUTION

ASSURE VENT AND DRAIN LINES DO NOT CHAFE ON OTHER COMPONENTS WHEN CONNECTED.

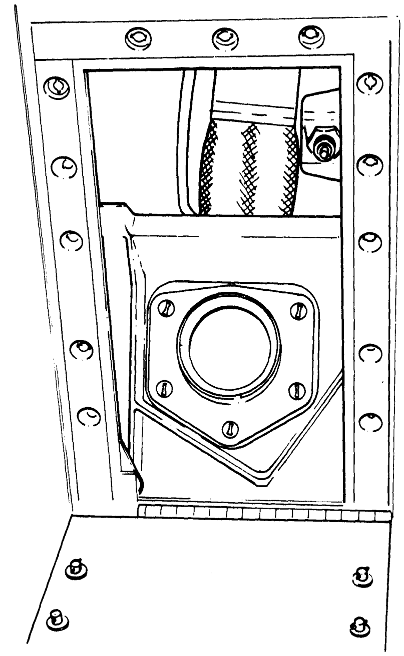
14. CONNECT SUMP PRESSURIZATION VALVE VENT LINE, ENGINE GEARBOX DRAIN LINE, GENERATOR DRAIN LINE, CSD NOSE DOME DRAIN LINE AND LOCKWIRE WITH MS20995NC32.

4C–2–8–(169–5)L

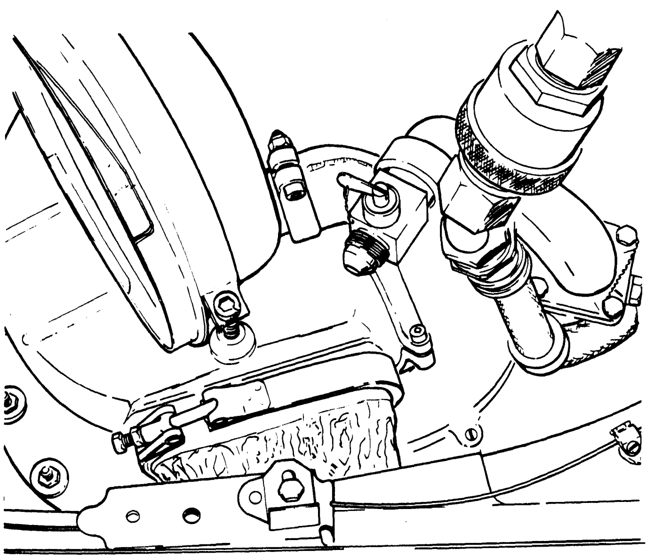
Figure 13-15. Engine Connection (Sheet 5 of 8)



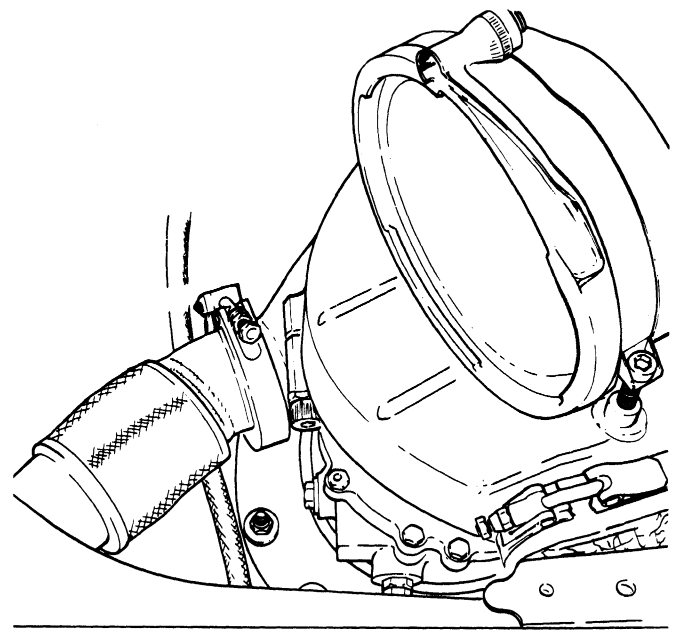
15. CONNECT MAIN FUEL CONTROL DRAIN LINE AT KEEL AND SECURE WITH MS20995NC32 LOCKWIRE.



17. POSITION STARTER PNEUMATIC DUCT AND INSTALL HI-SHEAR SCREWS.



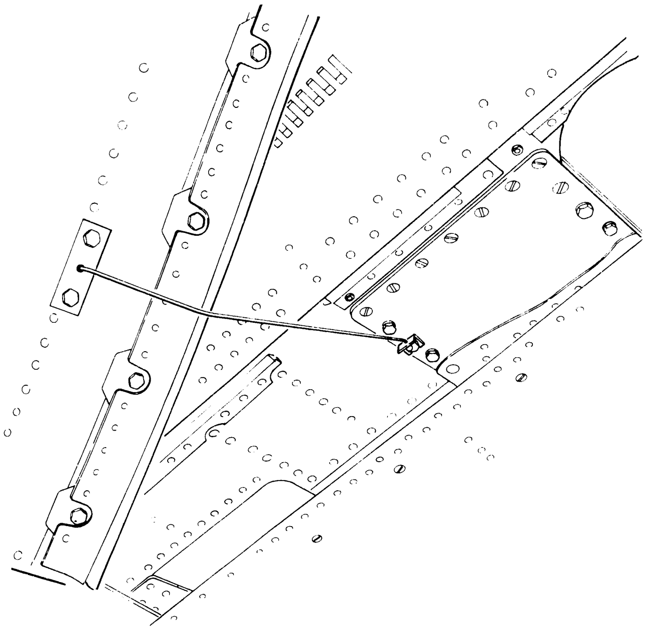
16. INSTALL STARTER EXHAUST DUCT AND SECURE WITH CLAMP. TORQUE COUPLING NUT 25 TO 30 INCH-POUNDS.

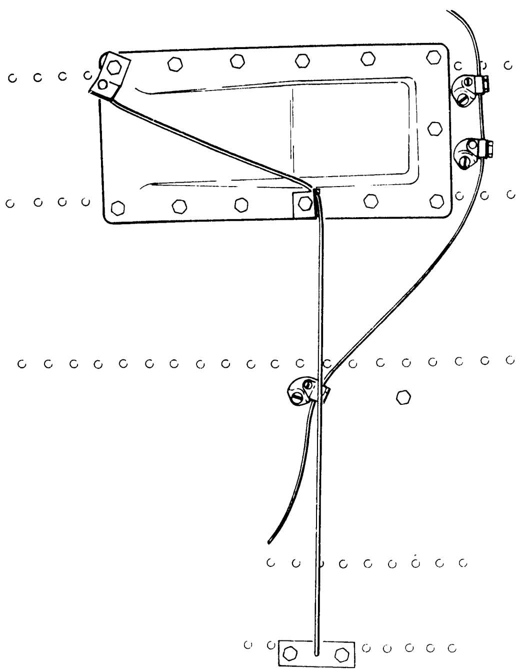


18. SECURE STARTER PNEUMATIC DUCT WITH COUPLING. TORQUE LOCKNUT AND SAFETY NUT 75 TO 80 INCH-POUNDS.

4C-2-8—(169-6)L

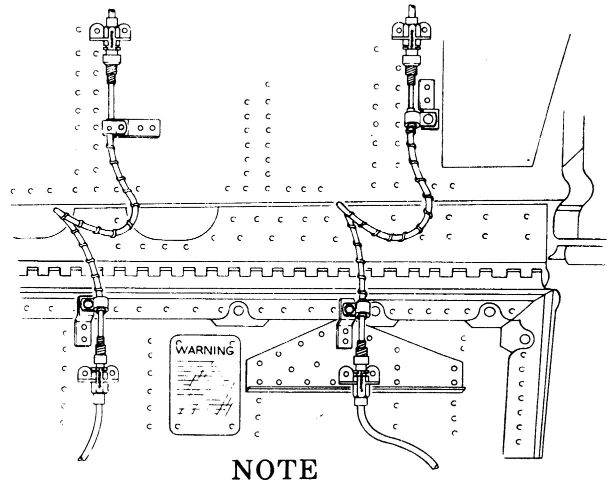
Figure 13-15. Engine Connection (Sheet 6 of 8)





19. DISCONNECT DOOR 92 L OR R RESTRAINT CABLE FROM UNDER SPEED BRAKE.

20. SECURE RESTRAINT CABLE TO INSIDE OF DOOR 92 L OR R.

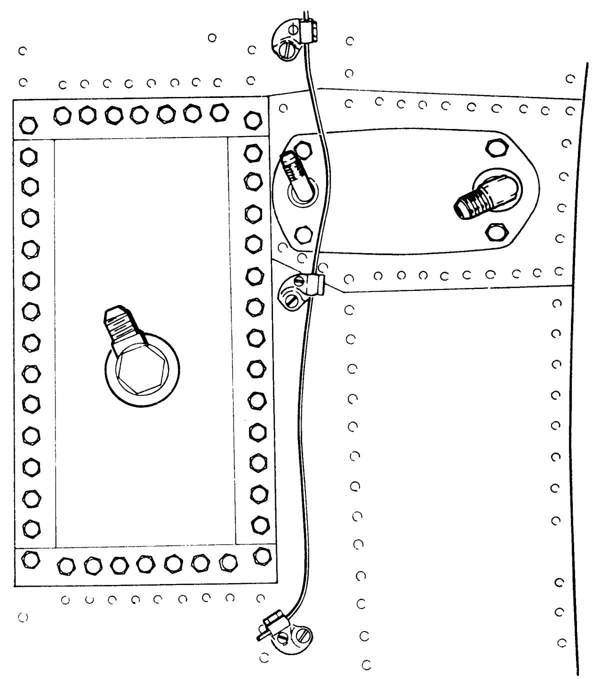


NOTE

REST DOOR 92L OR R ON CUTOUT OF DOOR 83.

LIGHT BURNISHING OR CONTACT OF FIRE DETECTOR LOOP ON STRUCTURE IS ACCEPTABLE.

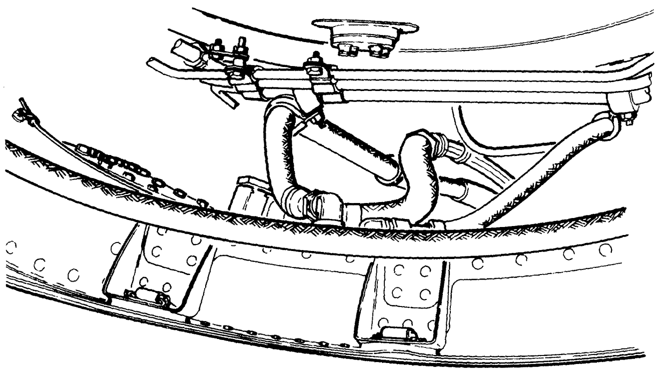
21. SWING DOOR 92L OR R UP. CHECK FIRE DETECTION ELEMENT AND DRAIN LINE CLEARANCE.



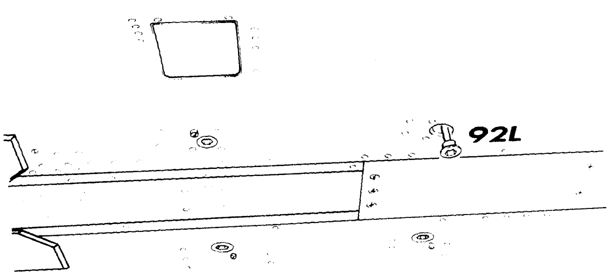
22. APPLY ANTI-SEIZE COMPOUND TO DRAIN ELBOWS.

4C-2-8-(169-7)L

Figure 13-15. Engine Connection (Sheet 7 of 8)



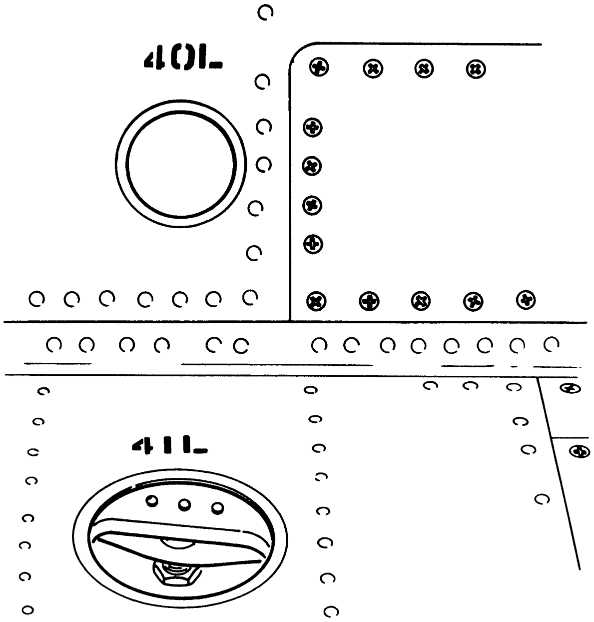
23. CONNECT AFT ENGINE DRAIN LINES. TORQUE ACCESSORY DRAIN LINE 225 TO 250 INCH-POUNDS. TORQUE COMBUSTION SECTION DRAIN LINE 65 TO 75 INCH-POUNDS. TORQUE TURBINE SECTION DRAIN LINE 135 TO 150 INCH-POUNDS. LOCKWIRE ALL FITTINGS WITH MS20995NC32.



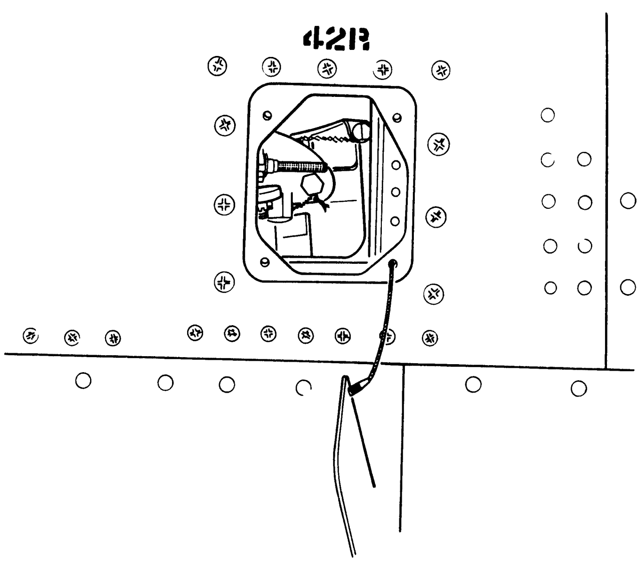
24. CLOSE DOOR 92 L OR R. TORQUE BOLTS 160 TO 190 INCH POUNDS. SAFETY BOLTS WITH MS20995NC32 LOCKWIRE.

4C-2-8-(169-8)L

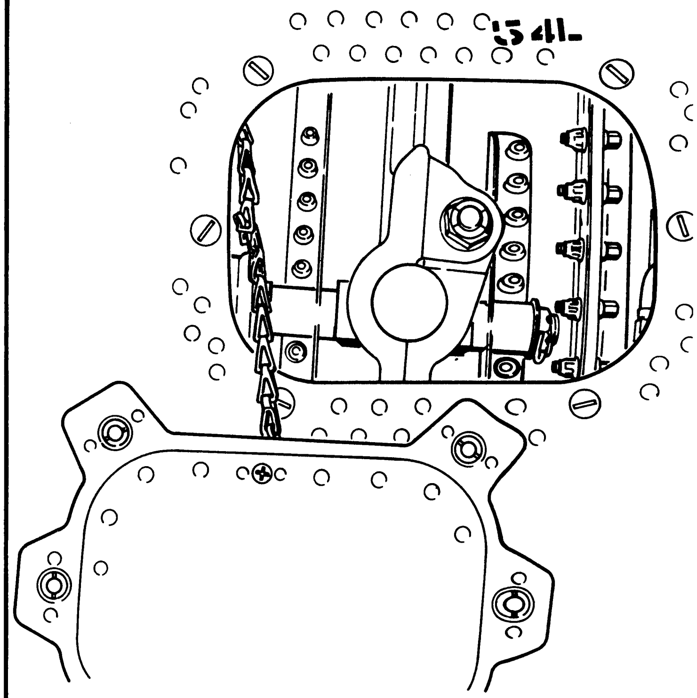
Figure 13-15. Engine Connection (Sheet 8 of 8)



1. CLOSE DOORS 40 L OR R AND 41 L OR R.

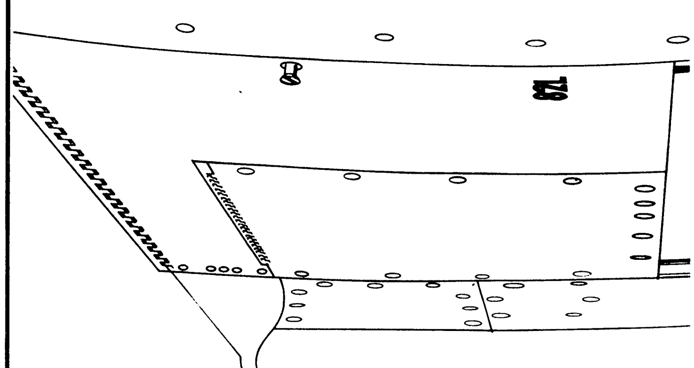


2. CLOSE DOOR 42 L OR R.



3. CLOSE DOOR 54 L OR R.

4. PERFORM COMPLETE POST ENGINE INSTALLATION GROUND OPERATION CHECKOUT. REFER TO SECTION II.



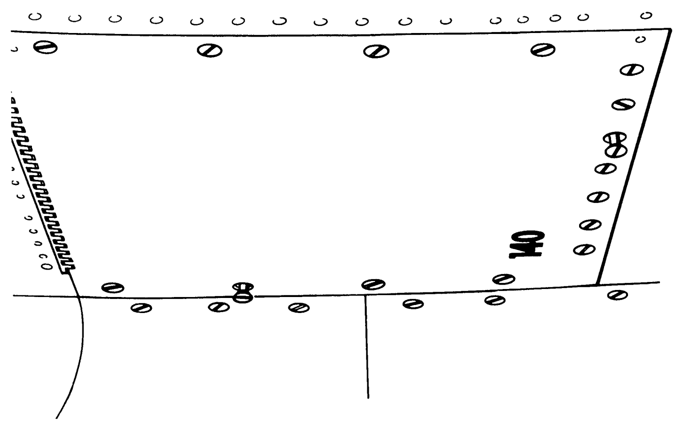
NOTE

SAFETY BOLTS WITH MS20995NC40 LOCKWIRE.

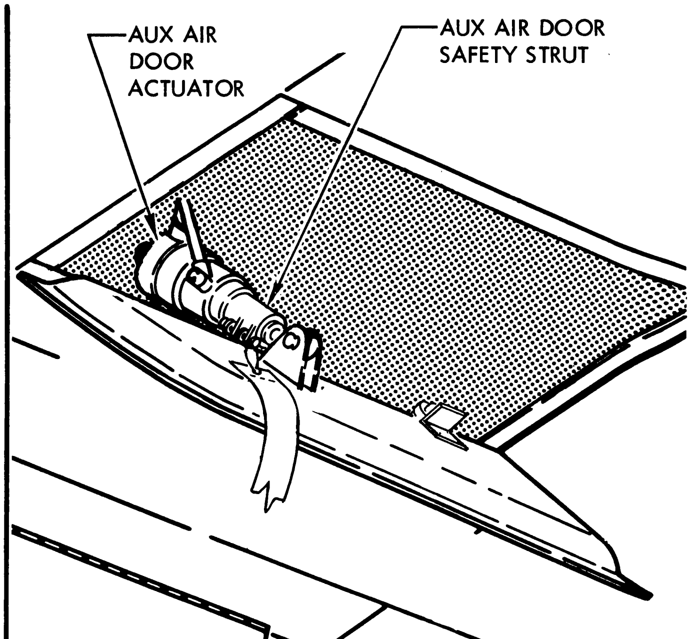
5. CLOSE DOOR 82 L OR R.

4C–2–8–(155–1)A

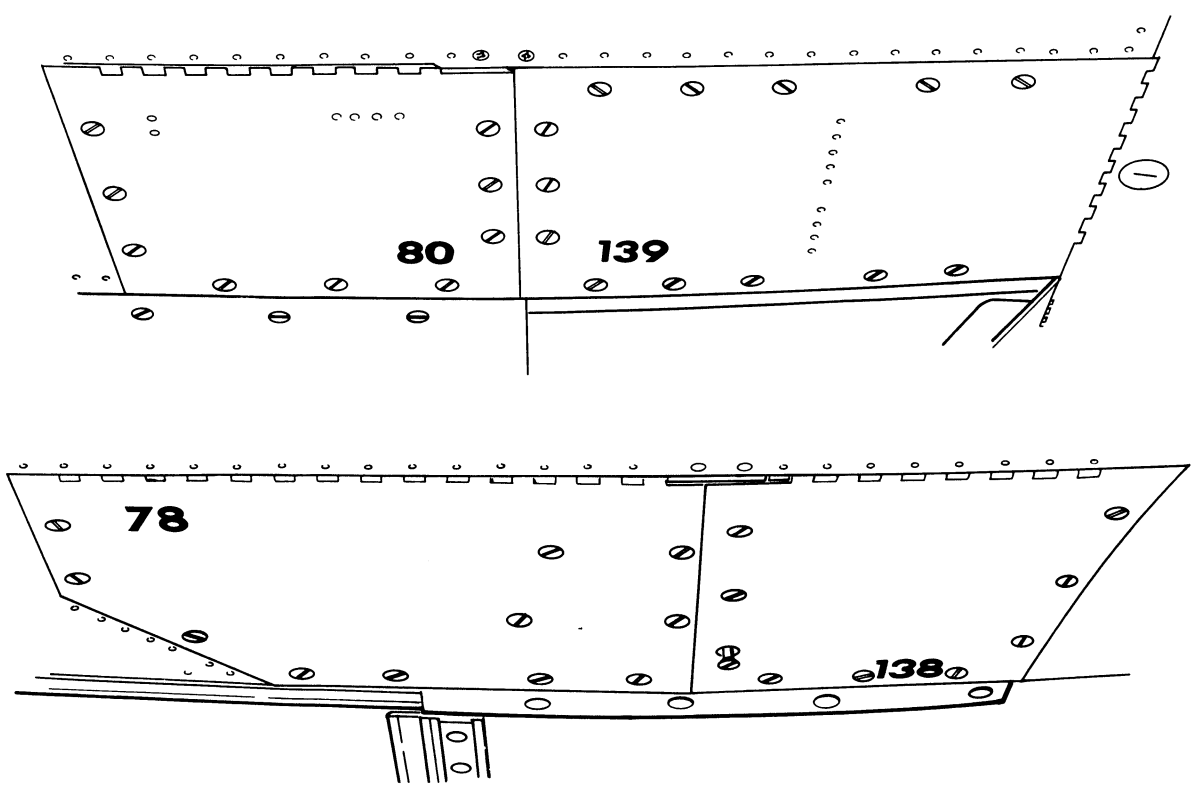
Figure 13–16. Engine Access Door Closing (Sheet 1 of 5)



6. FOR LEFT ENGINE, CLOSE DOOR 140.



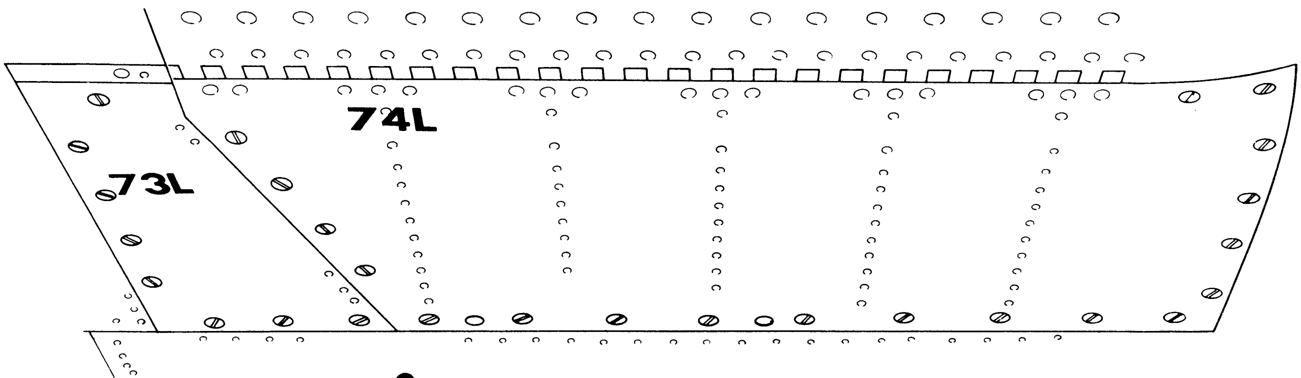
7. CONNECT ACTUATOR TO DOOR 81 L OR R. TORQUE ATTACHING BOLT 270 TO 300 INCH-POUNDS.



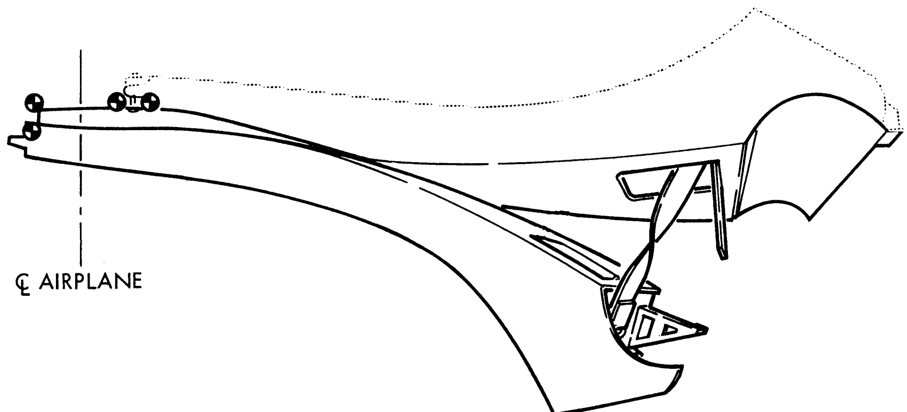
8. CLOSE DOORS 80 AND 139 OR 78 AND 138.

4C–2–8–(155–2)

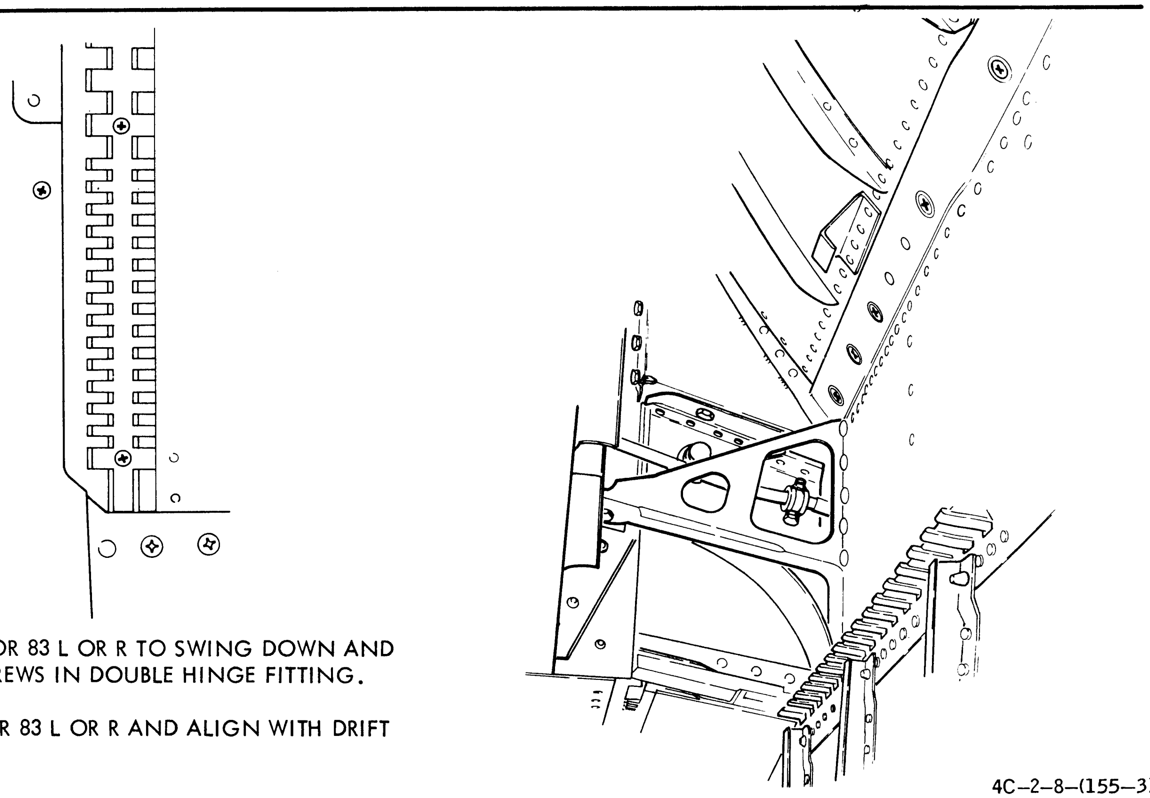
Figure 13-16. Engine Access Door Closing (Sheet 2 of 5)



9. CLOSE DOORS 73 L OR R AND 74 L OR R.



10. REMOVE STRAP HOLDING DOOR 83 L OR R OPEN AND STOW.



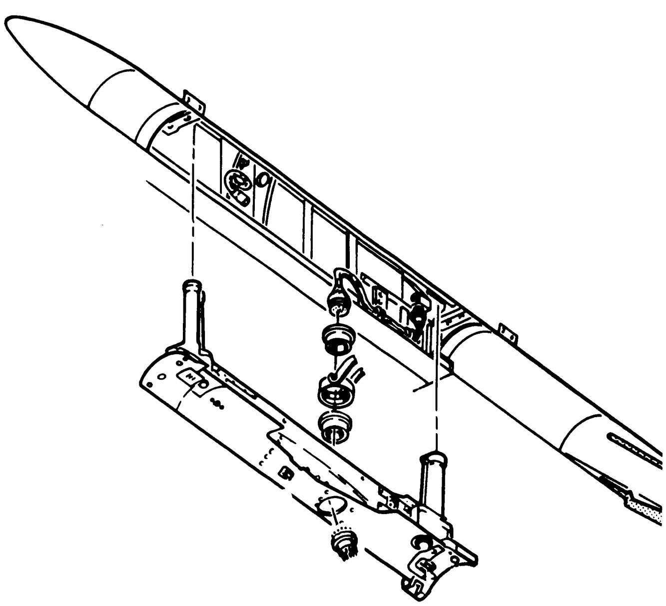
11. ALLOW DOOR 83 L OR R TO SWING DOWN AND INSTALL SCREWS IN DOUBLE HINGE FITTING.

12. CLOSE DOOR 83 L OR R AND ALIGN WITH DRIFT PIN.

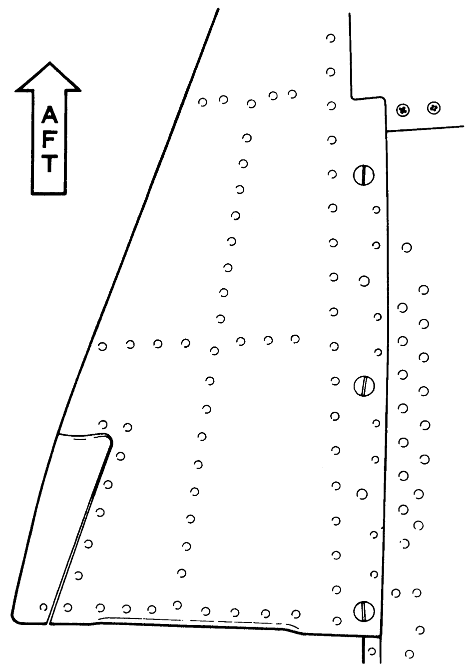
13. CLOSE DOOR 84 L OR R.

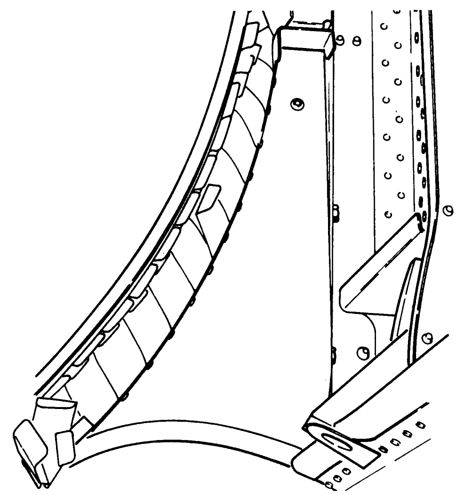
4C-2-8-(155-3)

Figure 13-16. Engine Access Door Closing (Sheet 3 of 5)



14. CONNECT ELECTRICAL CONNECTORS (2) AT MISSILE BULKHEAD AND INSTALL CLAMPS SECURING WIRE BUNDLE IN PLACE. INSTALL MISSILE RACK OR CAVITY COVER. REFER TO T.O. 1F-4C-2-18.

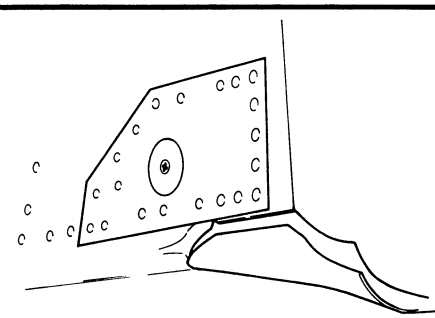




NOTE

ASSURE KEEL FAIRING FINGER SEALS ARE LUBRICATED BEFORE INSTALLATION.

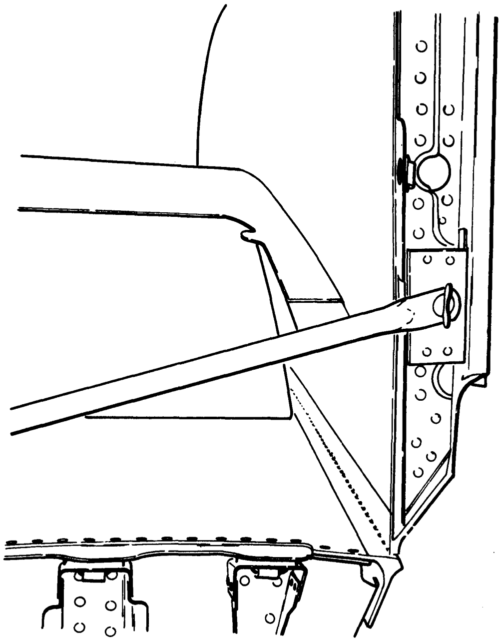
15. INSTALL KEEL FAIRING, AFT OF DOOR 96 L OR R.



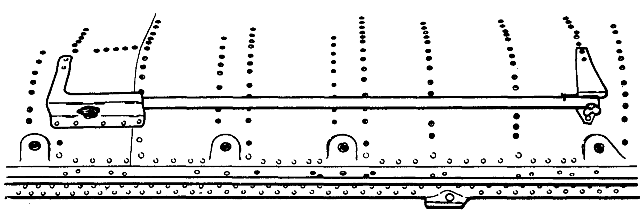
16. CLOSE AFT FUSELAGE TIE DOWN COVER.

4C-2-8-(155-4)

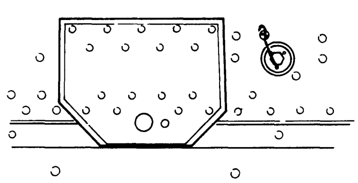
Figure 13-16. Engine Access Door Closing (Sheet 4 of 5)



17. REMOVE STRUT HOLDING DOOR 96 L OR R OPEN.

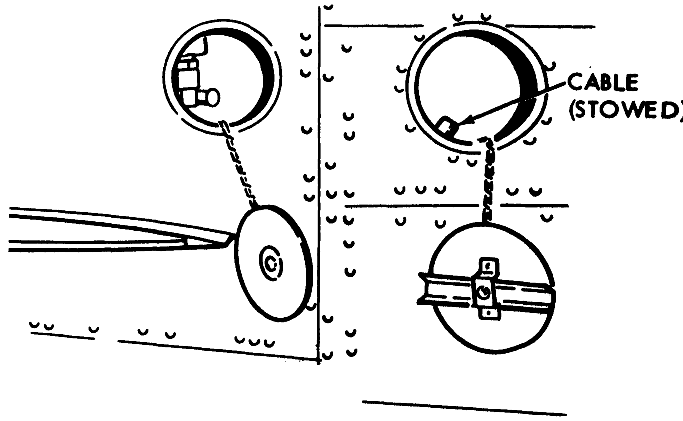


18. STOW STRUT INSIDE DOOR 96 L OR R AND SECURE WITH MS20995NC32 LOCKWIRE.



19. CLOSE DOOR 96 L OR R AND ALIGN WITH DRIFT PIN.

20. TORQUE BOLTS IN DOOR 96 L OR R 160 TO 190 INCH-POUNDS. LOCKWIRE BOLTS WITH MS20995NC32.

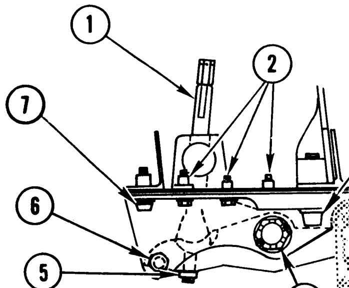


21. CONNECT COAX CABLE STOWED IN DOOR 96L OR R THROUGH DOORS 118L OR R AND 119L OR R.

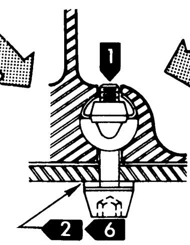
22. INSTALL DOORS 118 L OR R AND 119 L OR R.

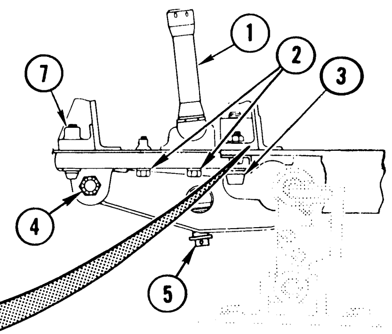
4C-2-8-(155-5)

Figure 13-16. Engine Access Door Closing (Sheet 5 of 5)



10 FORWARD TOP MOUNT

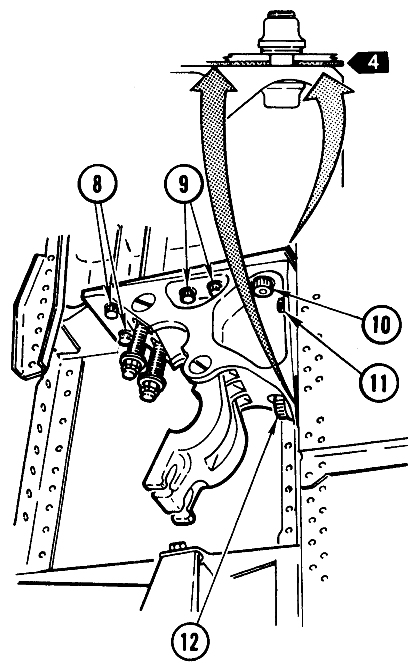




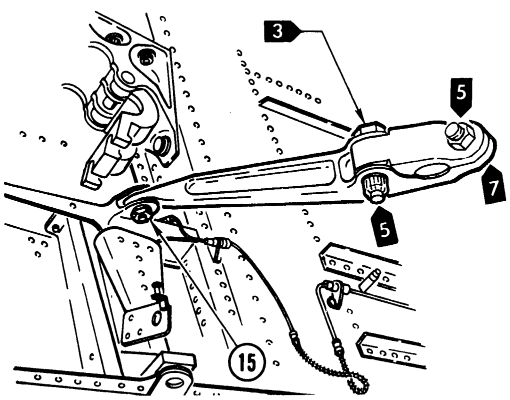
9 FORWARD TOP MOUNT

NOTES

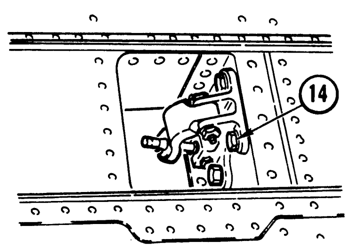
1. BOLT MUST EXTEND THROUGH BARREL NUT FULL CHAMFER OR 1/32 INCH, WHICHEVER IS GREATER.
2. ADD WASHERS AS NECESSARY.
3. ASSURE GAP OF 0.001 TO 0.005 INCH BETWEEN WASHER AND FACE OF LUG WITH NUT TORQUED.
4. SHIM 0.00 TO 0.08 INCH.
5. ASSURE BOLT PROTRUDES NUT MINIMUM OF 0.060 INCH.
6. ASSURE WASHER IS INSTALLED WITH CHAMFERED SIDE NEXT TO BOLT HEAD.
7. INSTALL TRUNNION CLAMP BOLTS THROUGH BRACE AND THEN THROUGH CAP.
8. INSTALL UPPER TANGENTIAL MOUNT FOR LEFT ENGINE WITH HEAD OF CLAMP BOLT POINTING FORWARD. INSTALL UPPER TANGENTIAL MOUNT FOR RIGHT ENGINE WITH HEAD OF CLAMP BOLT POINTING AFT.
9. BEFORE T.O.1F-4-991
10. AFTER T.O.1F-4-991



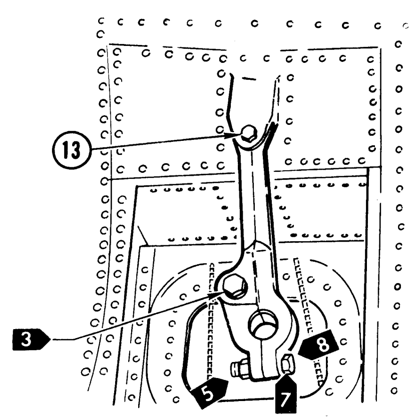
MAIN MOUNT



LOWER TANGENTIAL MOUNT



FORWARD SIDE MOUNT



UPPER TANGENTIAL MOUNT

1. BOLT, COMPRESSION OR TENSION
2. BOLT, WASHER
3. BOLT, WASHER, NUT, BARREL RETAINER
4. JAWBOLT, WASHER (2), NUT
5. NUT, WASHER, COTTER PIN
6. BOLT, WASHER (2), NUT, COTTER PIN
7. BOLT, WASHER
8. BOLT, WASHER, NUT
9. BOLT, WASHER, NUT
10. BOLT, WASHER, NUT
11. BOLT, WASHER (2), NUT
12. BOLT, WASHER, NUT
13. BOLT, WASHER, SPECIAL NUT
14. BOLT, WASHER, NUT
15. BOLT, WASHER, NUT, WASHER (2)

4C-2-8-(157)E

Figure 13-17. Airframe Installed Engine Mounts Removal and Installation

13-59. MAIN MOUNT REPLACEMENT.

13-60. Tools and Equipment.

Wrench, torque, 100 to 750 inch-pounds

13-61. Manpower Requirement.

a. Two men required.

13-62. Removal. See figure 13-17.

NOTE

Engine must be removed to replace main mount.

a. Remove bolts (8) and (9).

NOTE

Bolts (10), (11), and (12) may have loose shims between mount and structure. Record shim thickness and location for reinstallation.

b. Remove bolt (10).

c. On right mount open door 83L to gain access to nut.

d. Remove bolts (11) and (12).

e. Retain shims, under bolts (10), (11), and (12), for reinstallation.

13-63. Installation. See figure 13—17.

NOTE

Mount body and jaw have matched numbers and must be replaced as an assembly.

a. Position mount with shims and install bolts (12), (11), (10), (8), and (9). *Torque bolt (11) 50 to 70 inch—pounds. Torque bolt (12) 460 to 600 inch—pounds. Torque bolts (8) and (10) 480 to 690 inch—pounds. Torque bolts (9) 160 to 190 inch—pounds.*

13-64. TANGENTIAL MOUNTS REPLACEMENT.

13-65. Tools and Equipment.

Wrench, torque, 100 to 750 inch—pounds

13-66. Deleted.

13-67. Removal. See figure 13—17.

a. Deleted.

b. Remove bolt (13) and remove mount.

c. On lower tangential mount, remove bolt (15) and remove mount.

13-68. Installation. See figure 13—17.

NOTE

Mount body and jaw have matched numbers and must be replaced as an assembly.

Assure nuts have not lost their self-locking capability.

a. *Position lower mount and secure with bolt (15) 3 washers P/N 4M25—7 (1 under bolt and 2 under nut). Torque bolt 450 to 500 inch—pounds.*

b. *On upper tangential mount, position bolt (13) with nut and washer (1 under head). Torque bolt 450 to 500 inch—pounds.*

NOTE

Brace to be installed with curvature of brace to follow aircraft structure curvature.

c. *Position jaw into mount body and install pivot bolt, washers (2 — 1 under nut —1 under head) and nut. Tighten nut until .001 to.005 inch gap exists between washer and lug face. Install engine connection bolt, washers (2 — 1 under nut —1 under head) and nut. Torque engine connection bolt per figure 13—14.*

13-69. HYDRAULIC PUMP REPLACEMENT.

13-70. Tools and Equipment.

Wrench, torque, 0 to 150 inch-pounds

13-71. Materials.

Packing, 294492
Lubricant, Plastilube Moly Grade 3

13-72. Removal. See figure 13-18.

CAUTION

After hydraulic pump failure, effected system must be flushed and contamination analysis performed to prevent recurring failure. Refer to T O 1F-4C-2-6.

a. Open door 73 L or R and 74 L or R.

NOTE

Refer to T O 1F-4C-2-6 for uncoupling of quick disconnects.

b. Disconnect suction, pressure, and scavenge quick disconnects.

c. Disconnect seal drain line from pump mount pad.

d. Loosen coupling nut and remove hydraulic pump and gasket.

e. Remove all fittings from pump.

f. Inspect coupling boss face and elbows for signs of wear and corrosion. Wear will appear as bright spots where anodise coating is worn through to bare aluminum alloy. Corrosion will appear in the threaded areas.

g. Replace fittings that show any signs of wear or corrosion.

h. Install, clock and torque all pump couplings and fittings per T.O.1F–4( )–2–6.

CAUTION

Ensure that the applicable surge suppressor is installed in the proper hydraulic pump system.

13–73. **Installation.** See figure 13–18.

a. Install fittings in hydraulic pump. Refer to T.O.1F-4C-2-6.

b. Prime hydraulic pump. Refer to T.O.1F–4C–2–6.

c. Remove lead seals from pump.

d. Lubricate spline.

e. Install O–ring on mounting pad.

f. Position pump on transfer gearbox and secure with coupling. *Install locknut on coupling and torque 45 to 55 inch-pounds.*

NOTE

Replace safety nut each time coupling is unlatched.

g. *Install safety nut on coupling and torque 45 to 55 inch-pounds.*

h. *Connect seal drain line to hydraulic pump mount pad.*

CAUTION

Assure quick disconnects are properly locked. Refer to T.O.1F-4C-2-6.

Assure clamps are installed between hydraulic suction line and scavenge line in two places for each hydraulic pump. If clamps are not installed chafing can result.

i. *Connect suction, pressure, and scavenge quick disconnects.*

CAUTION

Do not push or pull on hydraulic hoses to check security. Over torqued or under torqued pump fittings could result.

13-74. INLET FUEL DISCONNECT ASSEMBLY REPLACEMENT.

13-75. Tools and Equipment.

Wrench, torque, 0 to 150 inch-pounds
Wrench, torque, 100 to 750 inch-pounds

13-76. Materials.

Seal, 125556-1 or S8P511
Packing, B58108
Lockwire, MS20995NC41
Petrolatum, VV-P-236

13-77. Removal. See figure 13-19.

WARNING

To prevent injury to personnel, make sure safety struts are installed on door 81L and R actuators.

a. Disconnect actuator from door 81L or R and open doors 82L or R and 22.

b. Ensure ENGINE MASTER switches and throttles are OFF.

c. Visually make sure engine fuel shutoff valve indicator in door 22 reads closed. If valve indicator reads open, perform steps f thru k of paragraph 13-43.

d. Drain engine fuel manifold.

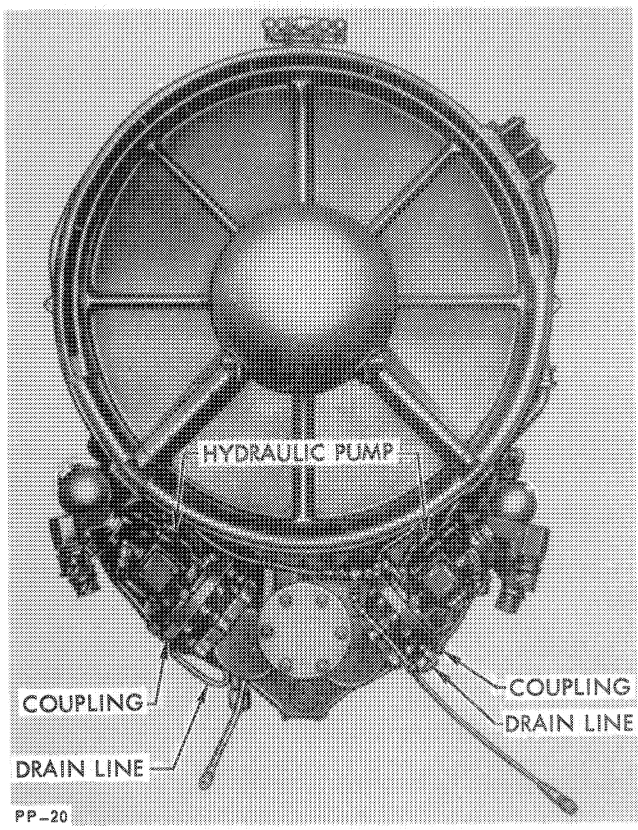
e. Loosen couplings and remove disconnect assembly.

f. If disconnect assembly is not to be immediately reinstalled, remove cap and seal from engine fuel manifold and install on keel flange. Secure cap with coupling. Torque coupling nut 60 to 80 inch-pounds.

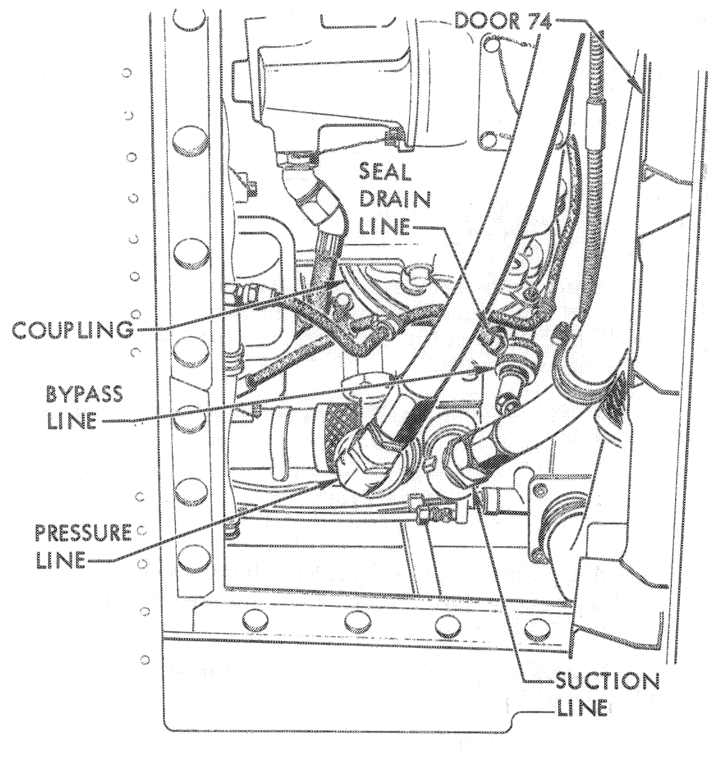
g. Cap ends of disconnect assembly.

13-78. Installation. See figure 13--19.

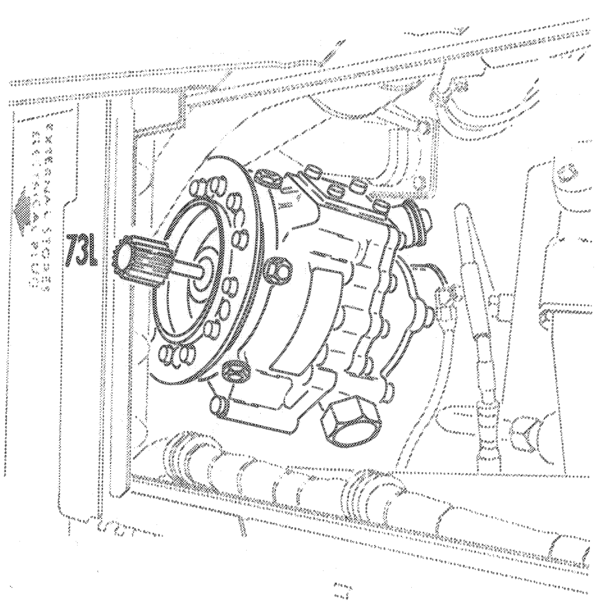
a. If cap installed on keel flange, visually make sure engine fuel shutoff valve indicator in door 22 reads closed. If valve indicator reads open, perform steps f thru k or paragraph 13-43.



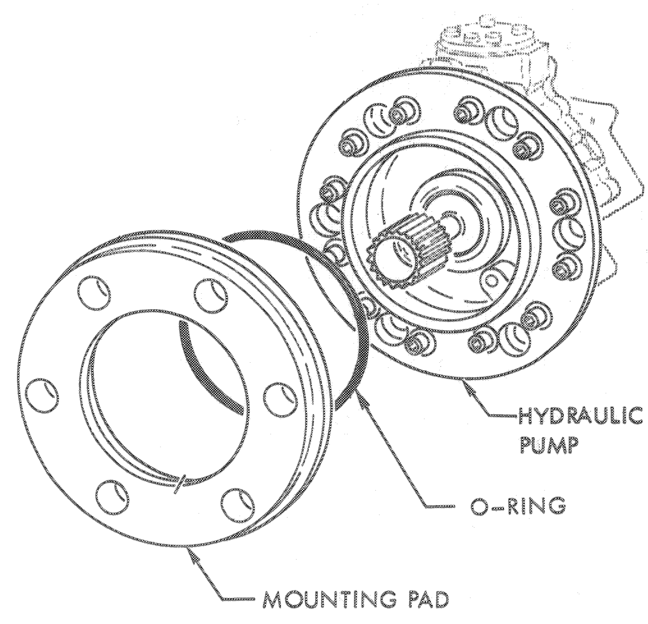
HYDRAULIC PUMP POSITION ON ENGINE



INSTALLED HYDRAULIC PUMP



HYDRAULIC PUMP REMOVAL



O-RING INSTALLATION

4C-2-8-(78)

Figure 13-18. Hydraulic Pump Removal and Installation

WARNING

Residual fuel may be present behind cap. To prevent the possibility of fire, collect drain fuel in a suitable container.

b. Open drain valve on engine fuel feed line down stream from shutoff valve in door 22 and drain all fuel from feed line.

CAUTION

Replace nuts each time coupling is unlatched to prevent worn nuts from backing off.

c. Remove cap and seal from keel flange and install on engine fuel manifold. *Install coupling with locknut and torque 60 to 80 inch-pounds. Add safety nut and torque 60 to 80 inch-pounds. Secure coupling with two strands of MS20995NC41 lockwire across T-bolt.*

d. Remove bolts from preloading flange.

e. Move flange aft to engage dowel in spring clip.

NOTE

If flanges align correctly without disturbing previous adjustment nut setting, subsequent retorquing and lockwiring is not required.

f. Loosen adjustment nut on disconnect assembly.

NOTE

Install inlet fuel disconnect assembly with adjustment nut next to engine fuel manifold.

If adjustment nut cannot be easily adjusted, remove nut and lubricate O-ring with petrolatum.

g. *Position disconnect assembly and, if necessary, adjust so flanges meet, with seals installed, but bellows does not deflect.*

CAUTION

Replace nuts each time coupling is unlatched to prevent worn nuts from backing off.

h. Install both couplings with self-locking nuts. *Torque outboard coupling 60 to 80 inch-pounds. Add safety nut and torque to 60 to 80 inch-pounds. Secure coupling with two strands of MS20995NC41 lockwire across T-bolt.*

i. *Torque adjustment nut 708 to 744 inch-pounds. Secure nut with MS20995NC41 lockwire.*

j. Disengage dowel pin from spring clip and move preloading flange forward.

k. *Install and torque flange bolts.*

l. *Torque inboard coupling nut 60 to 80 inch-pounds. Add safety nut and torque to 60 to 80 inch-pounds. Secure coupling with two strands of MS20995NC41 lockwire across T-bolt.*

m. Leak check inlet fuel disconnect assembly by momentarily placing ENGINE MASTER switch to ON and applicable throttle to IDLE.

n. Start engine and check for leaks. Refer to section II.

o. *Connect actuator to door 81L, or R, and close door 82L or R and door 22.*

13-79. BLEED AIR DUCTS REPLACEMENT.

13-80. Tools and Equipment.

Wrench, torque, 0 to 150-inch-pounds
Wrench, torque, 100 to 750 inch-pounds

13-81. Materials.

Gasket (3 reqd), MAD-06-005
Gasket (3 reqd), 50887-450-S
Lockwire, MS20995NC32

13-82. Removal. See figure 13-20.

CAUTION

Due to thin wall construction, bleed air ducts and bellows are extremely vulnerable to dents and scratches. To prevent damage, care in handling must be exercised during replacement. To decrease the possibility of damage, a protective wrapping can be applied to bellows area prior to removal or installation.

13-83. Main Bleed Air Duct.

13-84. Trailing Edge Bleed Air Duct.

a. Remove inboard and center couplings (2) and remove lower duct.

b. Loosen boot clamp (3) and remove outboard coupling (2).

c. Remove upper duct from shroud boot.

13-85. Installation. See figure 13-20.

13-86. Main Bleed Air Duct.

a. Place couplings (1) over duct.

b. *Hold duct in position and check alignment. If duct does not align, loosen clamps (4), (5), and coupling (6).*

NOTE

Ensure angle of conoseal gasket is correct.

c. Install duct using new gaskets. *Torque locknuts of couplings (1) 120 to 140 inch-pounds. Install safety nut and torque 120 to 140 inch-pounds.*

d. *If loosened, torque clamp nuts (5) alternately in 20 inch-pound increments and tap clamp until torque stabilizes at 150 to 170 inch- pounds.*

e. *If loosened, torque locknuts of coupling (6) 35 to 40 inch-pounds. Install safety nut and torque 35 to 40 inch-pounds. Secure coupling with double strand MS20995NC41 lockwire across T-bolt*

f. *If loosened, torque clamp (4) 10 to 15 inch-pounds.*

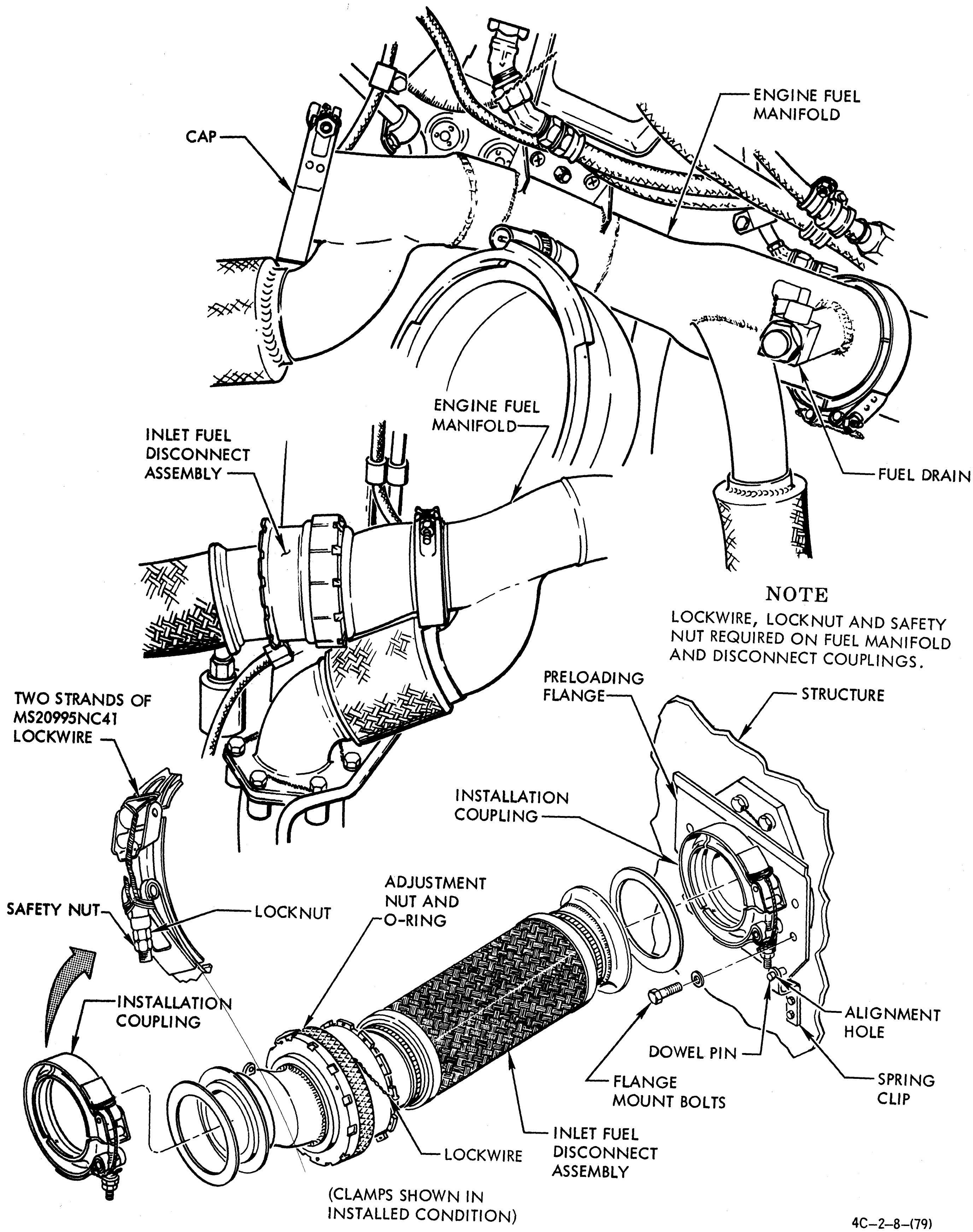


Figure 13-19. Inlet Fuel Disconnect Assembly Removal and Installation

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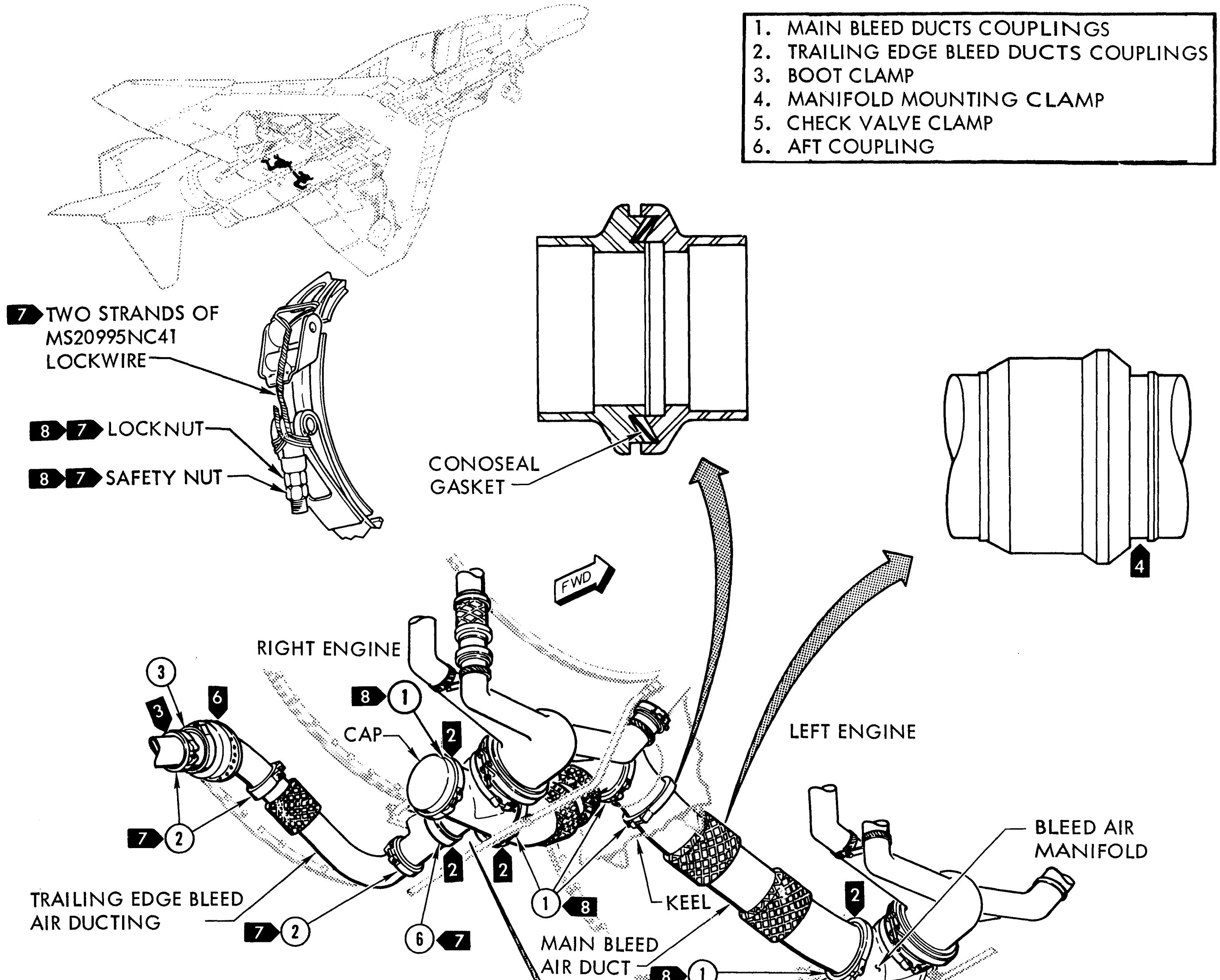
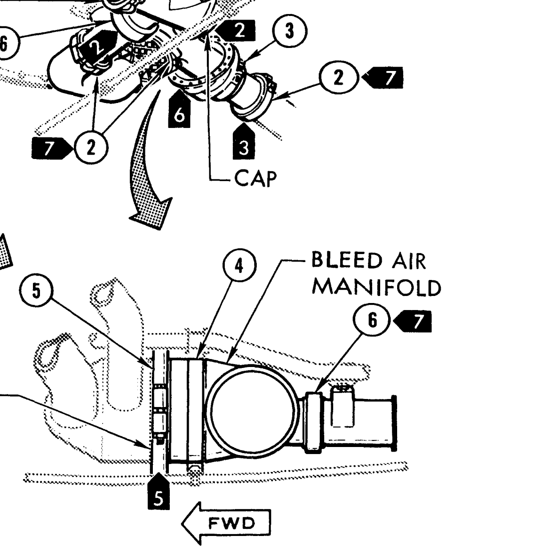




NOTES

1. GASKETS MUST BE REPLACED EACH TIME COUPLING IS LOOSENED.
2. POSITION COUPLING BOLTS BETWEEN 9 AND 3 O'CLOCK TO PREVENT CONTACT WITH DOORS.
3. TO INSURE PROPER DUCT ALIGNMENT DURING INSTALLATION, INSTALL COUPLING LOOSELY AND CHECK DUCT ALIGNMENT. MAX MISALIGNMENT 0.15; MAX GAP 0.10 IN.; PARALLEL MISALIGNMENT 1° ± 1° BETWEEN TWO MATING DUCTS.
4. MIN OF 0.10 INCH CLEARANCE AROUND CIRCUMFERENCE OF BALL JOINT BETWEEN OUTER RACE OF JOINT AND DUCT WALL.
5. GAP BETWEEN CLAMP HALVES 0.32 INCH MAX AFTER TORQUE.
6. 0.25 INCH MIN CLEARANCE BETWEEN DUCT AND SHROUD.
7. LOCKWIRE, LOCKNUT AND SAFETY NUT REQUIRED ON COUPLINGS.
8. LOCKNUT AND SAFETY NUT REQUIRED ON COUPLINGS.
9. 0.25 INCH MINIMUM CLEARANCE BETWEEN TRAILING EDGE BLEED AIR DUCTING AND SURROUNDING HARDWARE.

4C-2-8-(80)A

Figure 13-20. Bleed Air Ducts Removal and Installation

13-87. Trailing Edge Bleed Air Duct.

a. Insert upper section of duct through shroud boot.

b. Place coupling on duct, position duct, using new gasket, and latch coupling over flanges.

c. Install lower section of duct, using new gaskets, and latch couplings over flanges.

d. *Align ducts and tighten couplings (2) uniformly to a torque of 75 to 80 inch-pounds. Add safety nuts and torque to 75 to 80 inch-pounds.*

e. *Lockwire couplings with double strand MS20995NC41 lockwire across T-bolts.*

f. *Torque boot clamp (3) 15 to 30 inch-pounds.*

g. *Assure coupling bolts are positioned to clear access doors.*

h. *Assure clearance between bleed air ducts and fuel drain line.*

13-88. **BLEED AIR CHECK VALVE REPLACEMENT.** The bleed air check valve is installed during engine build-up. Refer to T.O.1F-4C-10.

13-89. **ENGINE ACCESS DOOR BOLT REPLACEMENT.** See figure 13-21.

13-90. **Door 92 Bolt Removal.**

a. Pull bolt (4) against door and turn clockwise to engage left hand threads.

b. Continue turning bolt clockwise until bolt is removed from door.

c. Inspect bolt for galling, scratches in root radius, cracks, and stripped or worn threads.

d. Inspect anchor nut (3) for stripped or worn threads.

13-91. **Door 92 Bolt Installation.**

a. Insert bolt (4) into hole in door and turn counterclockwise to engage left hand threads in door.

b. Continue turning bolt counterclockwise until threads on bolt pass through threads in door.

13-92. **Door 96 Bolt Removal.**

a. Remove two screws (9) from stop (8).

b. Slide stop (8) up and remove bolt (7).

c. Inspect bolt for galling, scratches in root radius, cracks, and stripped or worn threads.

d. Inspect anchor nut (6) for stripped or worn threads.

13-93. **Door 96 Bolt Installation.**

a. Insert bolt (7) into hole in door.

b. Slide stop (8) into position between bolt shoulder and bolt head.

c. Secure stop with screws (9).

13-94. *Quality Assurance Summary.*

a. *Assure bolts are free of cracks and burrs.*

b. *Assure bolt and nut threads are serviceable.*

c. *On door 96 bolts, assure bolt stop and retaining screws are installed.*

SHOP MAINTENANCE

13-95. MAINTENANCE PROCEDURES.

13-96. This section provides maintenance procedures applicable to components/systems when removed from the aircraft. Table 13-2 lists the functional line replaceable units (LRU) of the system with the location of applicable maintenance procedures. Shop maintenance procedures, when contained in this manual, are referenced by paragraph numbers; when contained in accessory publication, the T.O. numbers of the applicable manuals are listed. Manuals in the F-4 series or in general aircraft series are listed when containing procedures directly applicable to the LRU. When separate overhaul/illustrated parts breakdown manuals have been provided, the T.O. numbers are listed.

13-97. PRESERVATION AND PACKAGING.

13-98. **Preservation.** Refer to T.O.2J-1-18 for preservation instructions.

13-99. **Packaging.**

13-100. Components to be forwarded to the next higher level of maintenance for repairs, test, or check must be cleaned, preserved, and packaged for protection against physical and mechanical damage during subsequent handling, shipping, and storage. For preservation and packaging methods referred to herein, refer to AFP 71-4 volumes 1 and 2. Components packed for forwarding must be identified, marked, and documented in accordance with applicable Air Force procedures.

Table 13-2. Line Replaceable Units

Line Replaceable Unit	Manufacturers Part Number	Applicable Maintenance Procedures/Publications Shop (Intermediate Level)	Applicable Maintenance Procedures/Publications Overhaul/IPB
Engine	J79	T.O.1F-4C-10	
Forward Top Mount	32-50042	T.O.1F-4C-3-1-4	None Required

CONTINUED

Table 13-2. Line Replaceable Units

Line Replaceable Unit	Manufacturers Part Number	Applicable Maintenance Procedures/Publications Shop (Intermediate Level)	Applicable Maintenance Procedures / Publications Overhaul/IPB
Forward Side Mount	32-50169	T.O.1F—4C—3—1—4	None Required
Main Mount	32-50047	T.O.1F—4C—3—1—4	None Required
Tangential Mount	32—51072	T.O. 1F—4C—3—1—4	None Required
Hydraulic Pump	53-69055	T.O.1F—4C—2—6	
Inlet Fuel Disconnect Assembly	2502511	Paragraph 13—102	
Bleed Air Ducts	2502551 (left engine) 2502552 (right engine)	T.O.1F—4C—3—1—4	None Required
Engine Access Door Bolts	None Required	Paragraph 13—89	

13-101. COMPONENTS.

13-102. INLET FUEL DISCONNECT ASSEMBLY INSPECTION. P/N 2502511.

a. For any 45° circumferential segment around bellows section (measured from stand-off collar), not more than 50 percent of wire braid (36 wires) shall be broken or missing. Also, not more than two adjacent, parallel strands (12 wires per strand) shall be broken or missing.

b. Cuts, tears, scratches, etc., are allowed on teflon sleeve provided sleeve keeps wire braid from contacting bellows.

c. Dents and scratches are allowed on compensator provided movement of rotating compensator is not restricted. A proof pressure test of 120 psig is required to assure no leakage in cases where sealing qualities may be affected.

d. Damage to half ring (flange located in center of articulated bellows section) is allowed provided support structure beneath half ring is not distorted. Distortions may be observed from interior of line.

e. Dents not to exceed 10 percent of fuel manifold diameter may be accepted.

f. Nicks, scratches, or gouges not more than 0.010 inch in depth are permissible.

g. Dents which produce sharp creases in bellows area are not acceptable. Inspection of bellows shall be accomplished from interior of line. Bellows section showing any other damage shall be subjected to a proof test and no leaks shall be allowed.

h. Mating surfaces on end flanges shall be flat within 0.005 inch. Nicks, scratches, or dents which affect sealing properties of flange are not acceptable.

13-103. **ENGINE BUILD-UP.** Refer to T.O.1F-4C-10 for QEC installation.

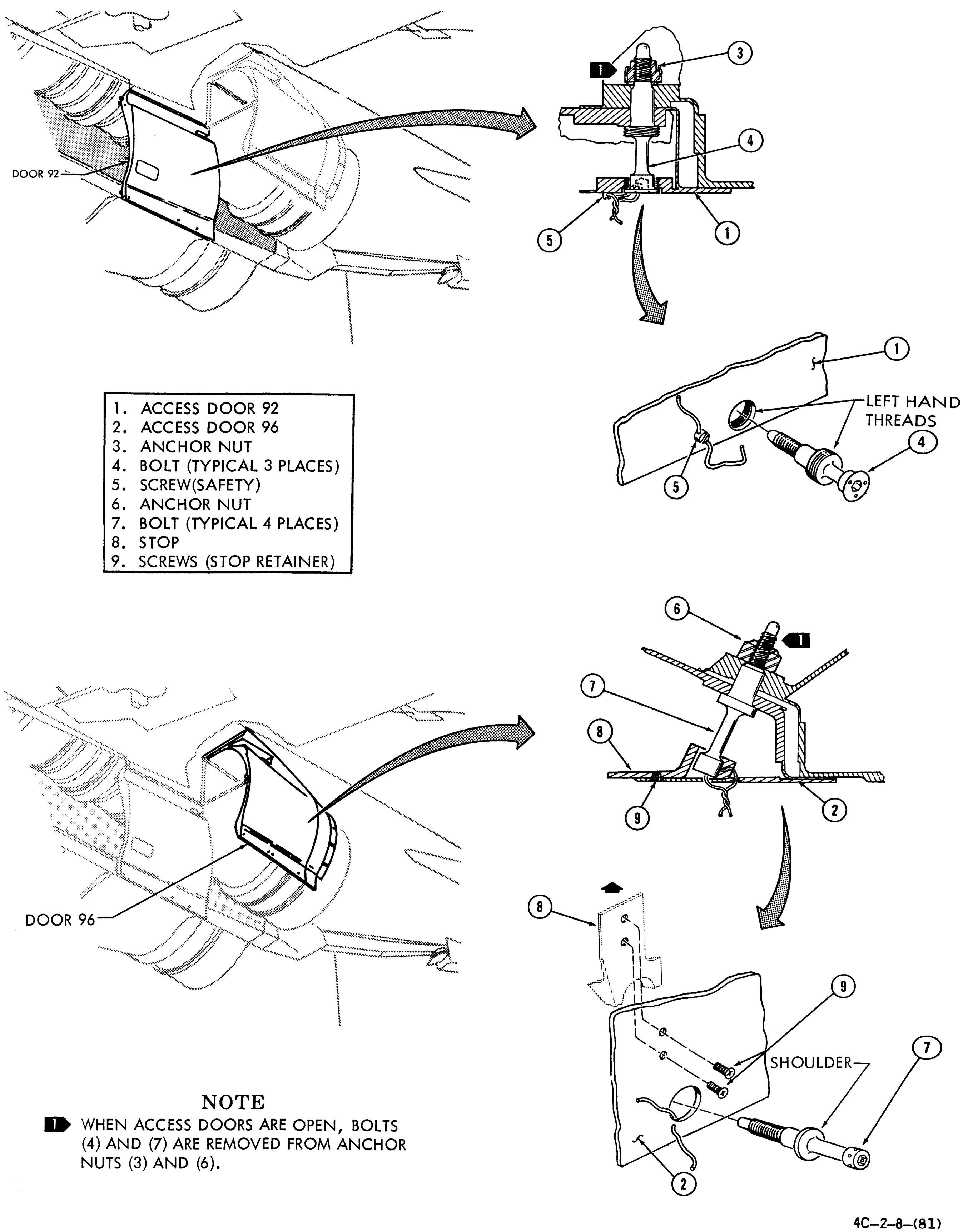


Figure 13-21. Engine Access Door Bolt Removal and Installation

SECTION XIV

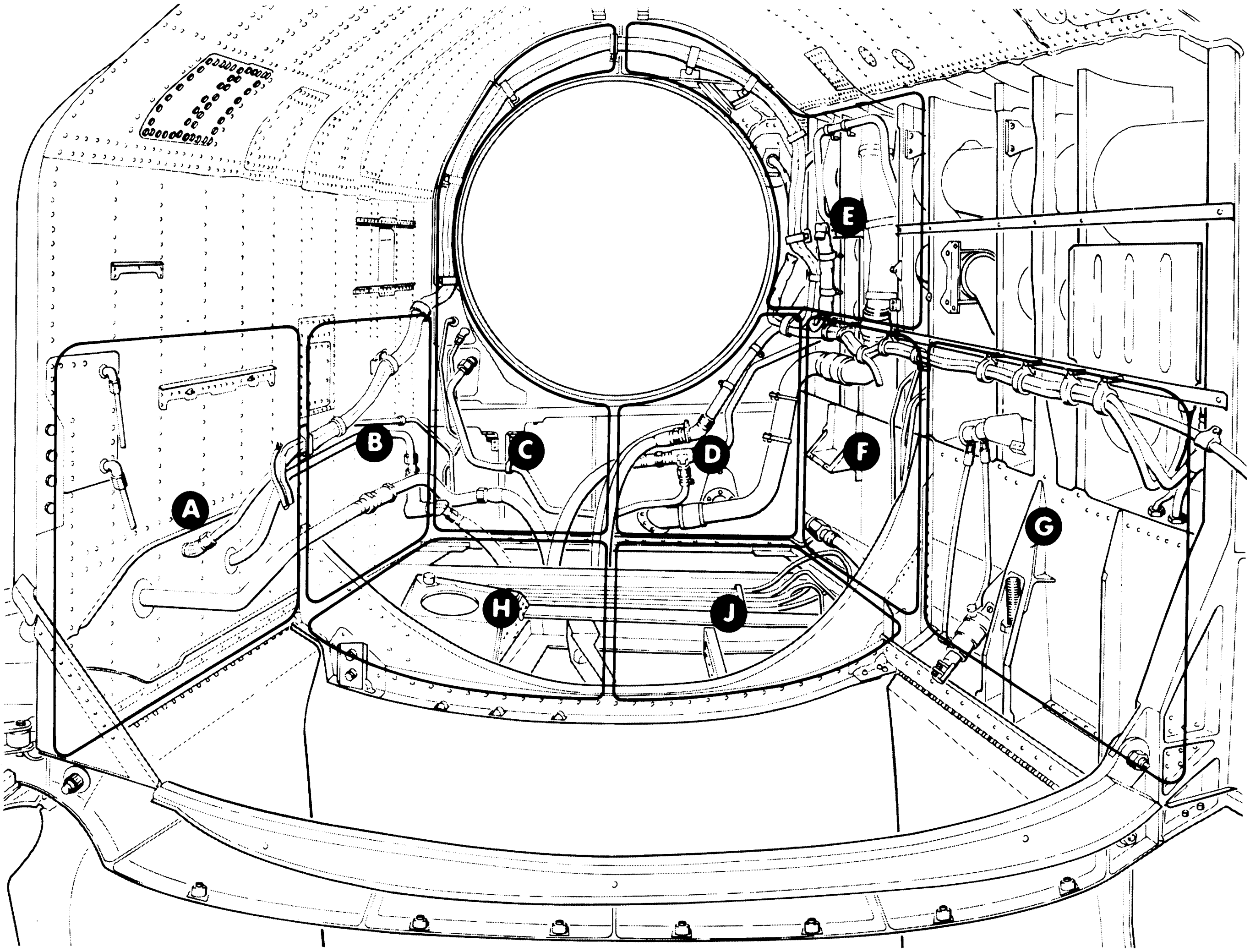
ENGINE BAY CONFIGURATION

INTEGRITY GUIDE

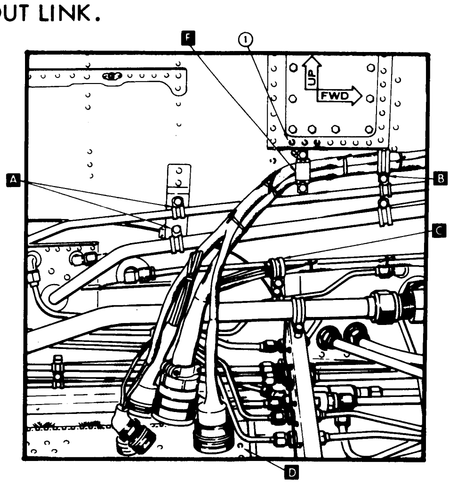
14-1. **GENERAL.** See figure 14-1.

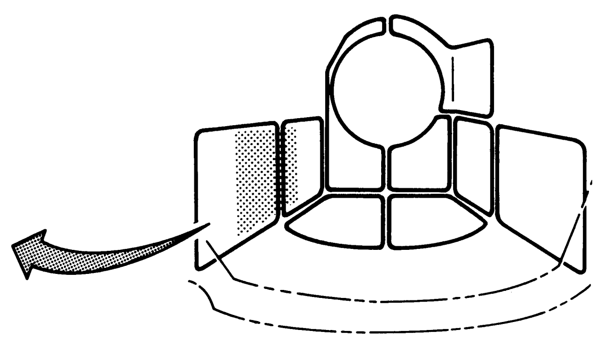
14-2. The illustrations in this section provide proper wire bundle and line routing information along with clamping data. Adherence to details will assure clearances and prevent chafing.

14-3. Each illustration in this section is a master configuration guide of a zone of either the left or right engine compartment. To locate a zone refer to figure 14-2 for the left engine bay and figure 14-16 for the right engine bay.



THIS IS THE ENGINE BAY ZONE LOCATION ILLUSTRATION USED TO LOCATE AND IDENTIFY SPECIFIC AREAS OF THE ENGINE BAYS. IT IS ALSO USED, IN ALPHABETICAL SEQUENCE, FOR QUALITY CONTROL INSPECTION. THE ZONES PROCEED ALPHABETICALLY, FORWARD FROM THE OUTBOARD AREA OF THE DROPOUT LINK, AROUND THE BYPASS BELLMOUTH, AND AFT TO THE INBOARD PORTION OF THE DROP-OUT LINK.





ZONE A
LEFT ENGINE BAY

THE SHADED PORTION OF THE ZONE OUTLINE ON EACH SHEET DENOTES THE PORTION OF THAT ZONE WHICH IS COVERED BY THAT SHEET. PORTIONS OF ZONES PROCEED CLOCKWISE UNTIL THE COMPLETE ZONE IS COVERED.

4C-2-8-(82)

Figure 14-1. Zone Location Example

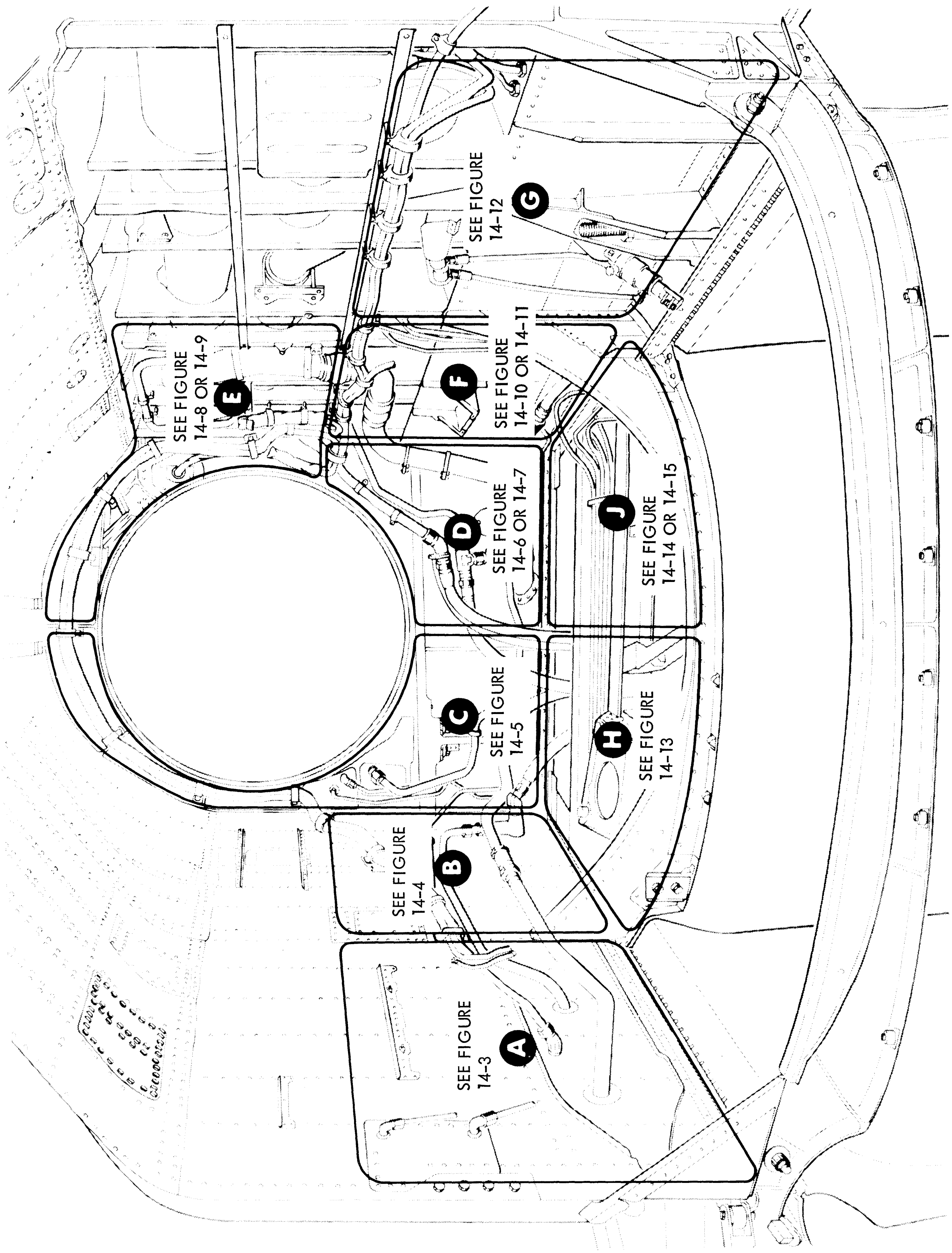
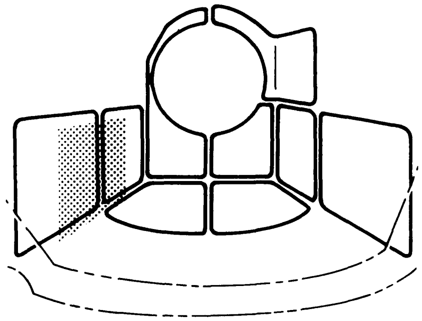


Figure 14-2. Left Engine Bay Orientation



CRITICAL INFORMATION			
INDEX	MINIMUM CLEARANCE	ANGLE	DESCRIPTION
1	1 2		WIRE BUNDLE CLAMP

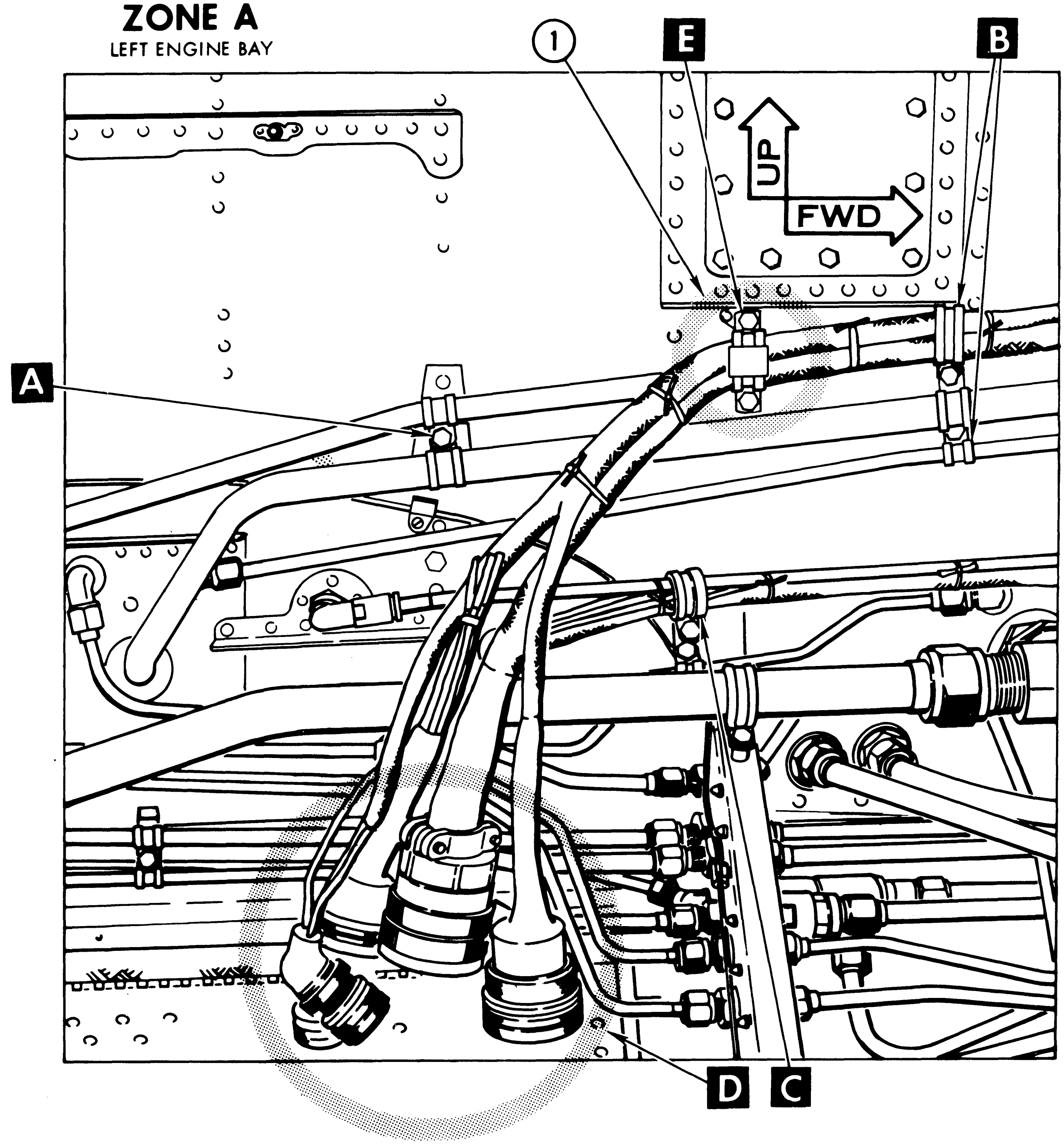


Figure 14-3. Left Engine Bay Zone A (Sheet 1 of 4)

NOTES

1. DISTANCE FROM AFT END OF LAST CLAMP TO FACE OF PLUG 52P632 IS 14.75 $^{+0.25}_{-0.00}$ INCHES. DISTANCE FROM AFT EDGE OF LAST CLAMP TO FACE OF PLUG 3P635 IS 13.50 $^{+0.25}_{-0.00}$ INCHES.
2. ASSURE TWO 0.50 DIA., 1 INCH LONG SHRINK SLEEVES ARE INSTALLED ON CLAMP.

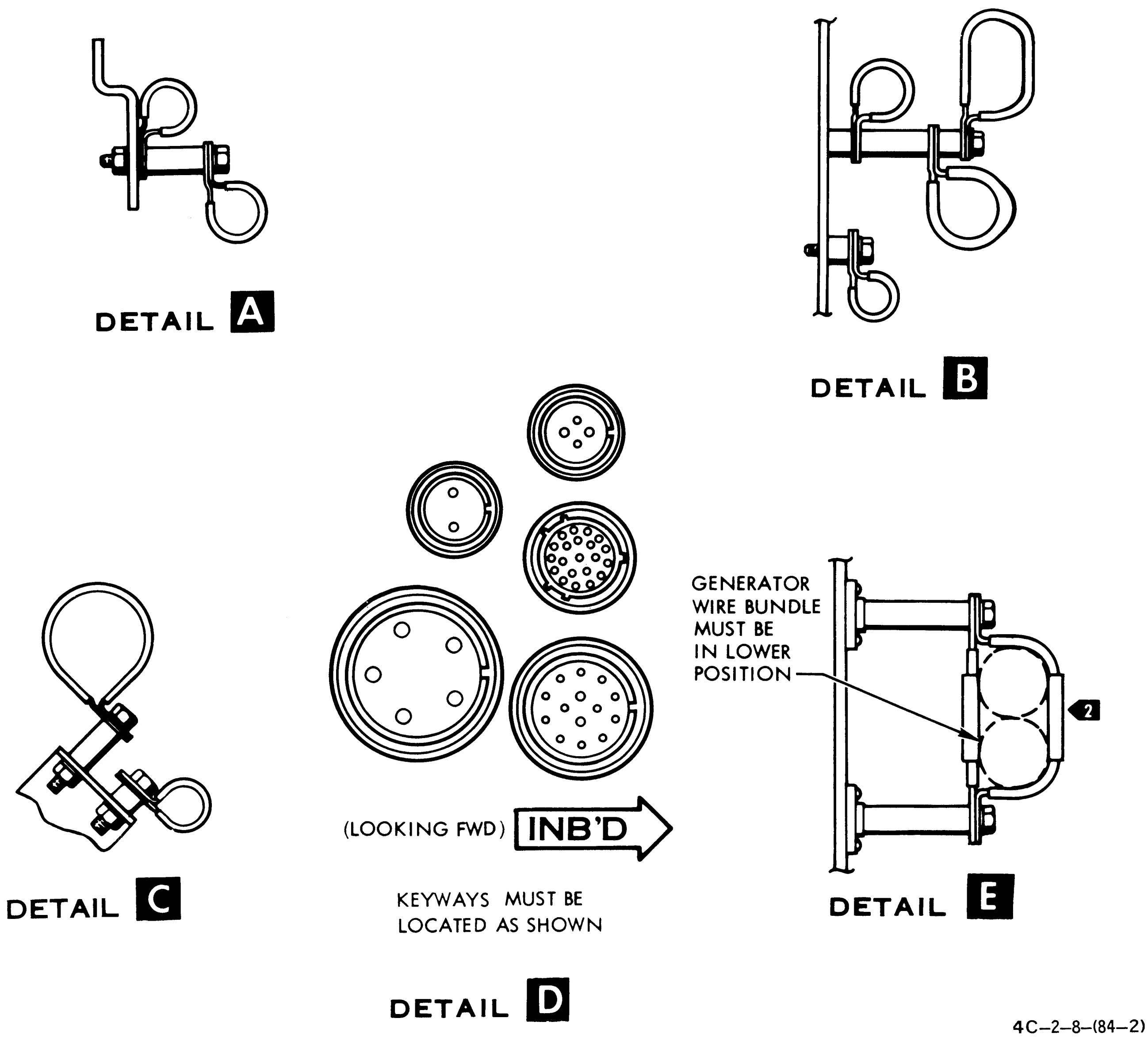
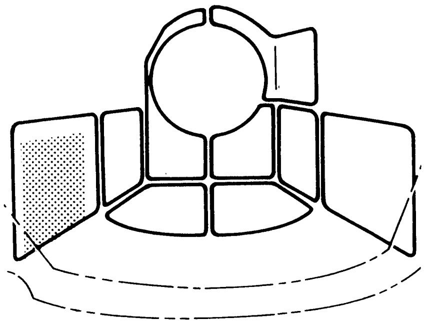


Figure 14-3. Left Engine Bay Zone A (Sheet 2 of 4)



CRITICAL INFORMATION			
INDEX	MINIMUM CLEARANCE	ANGLE	DESCRIPTION
2	3 0.090		STIFFENER FLANGE TO HYDRAULIC LINE

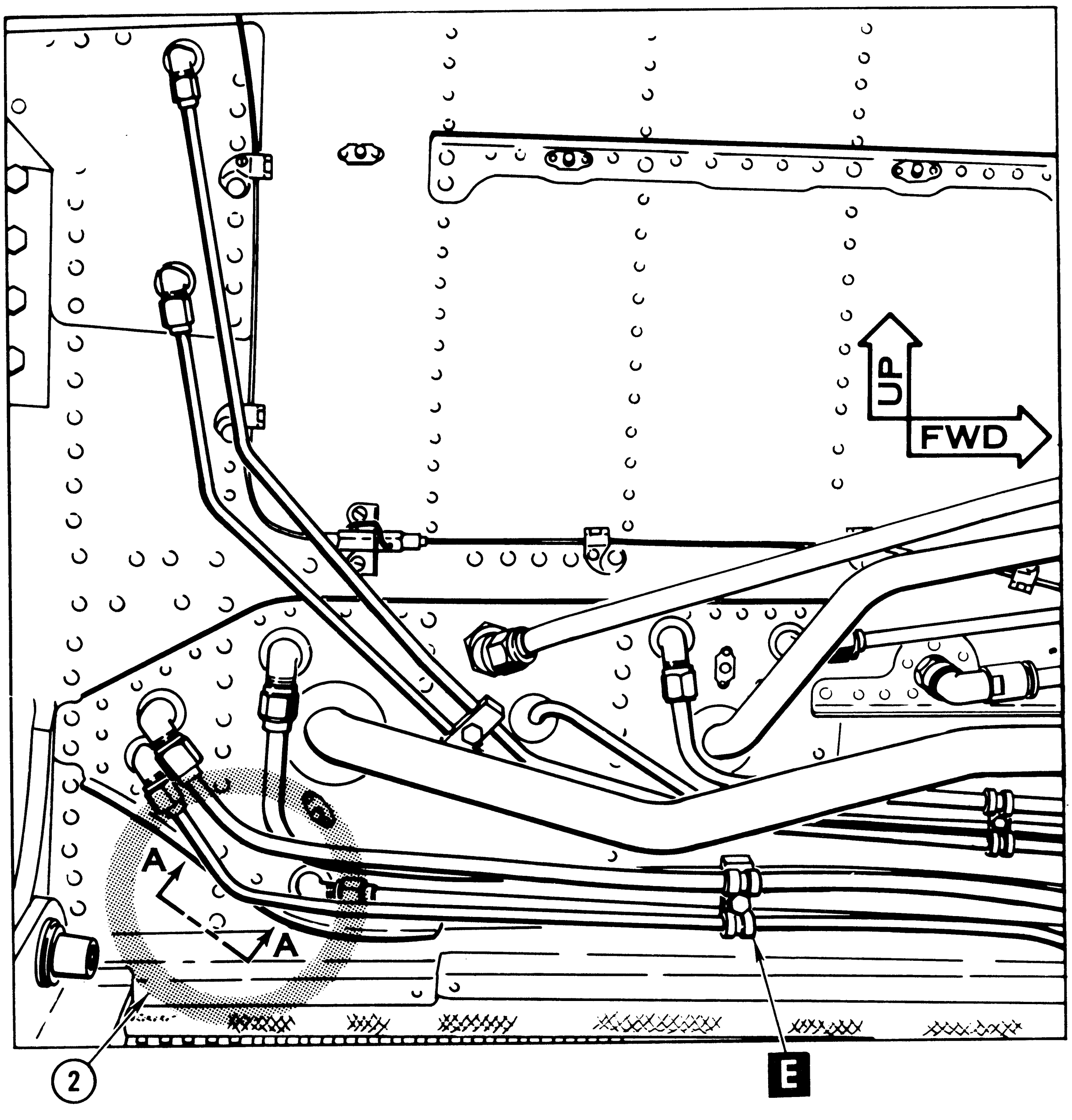
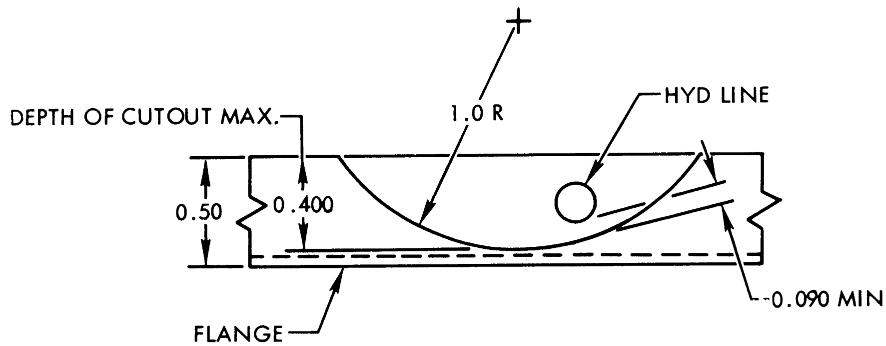


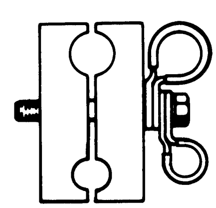
Figure 14-3. Left Engine Bay Zone A (Sheet 3 of 4)

NOTE

3 IF INSUFFICIENT CLEARANCE EXISTS BETWEEN STRUCTURAL STIFFENER FLANGE AND HYDRAULIC LINE, TRIM FLANGE AS SHOWN IN VIEW A-A



3 VIEW A-A



DETAIL E

4C-2-8-(84-4)

Figure 14-3. Left Engine Bay Zone A (Sheet 4 of 4)

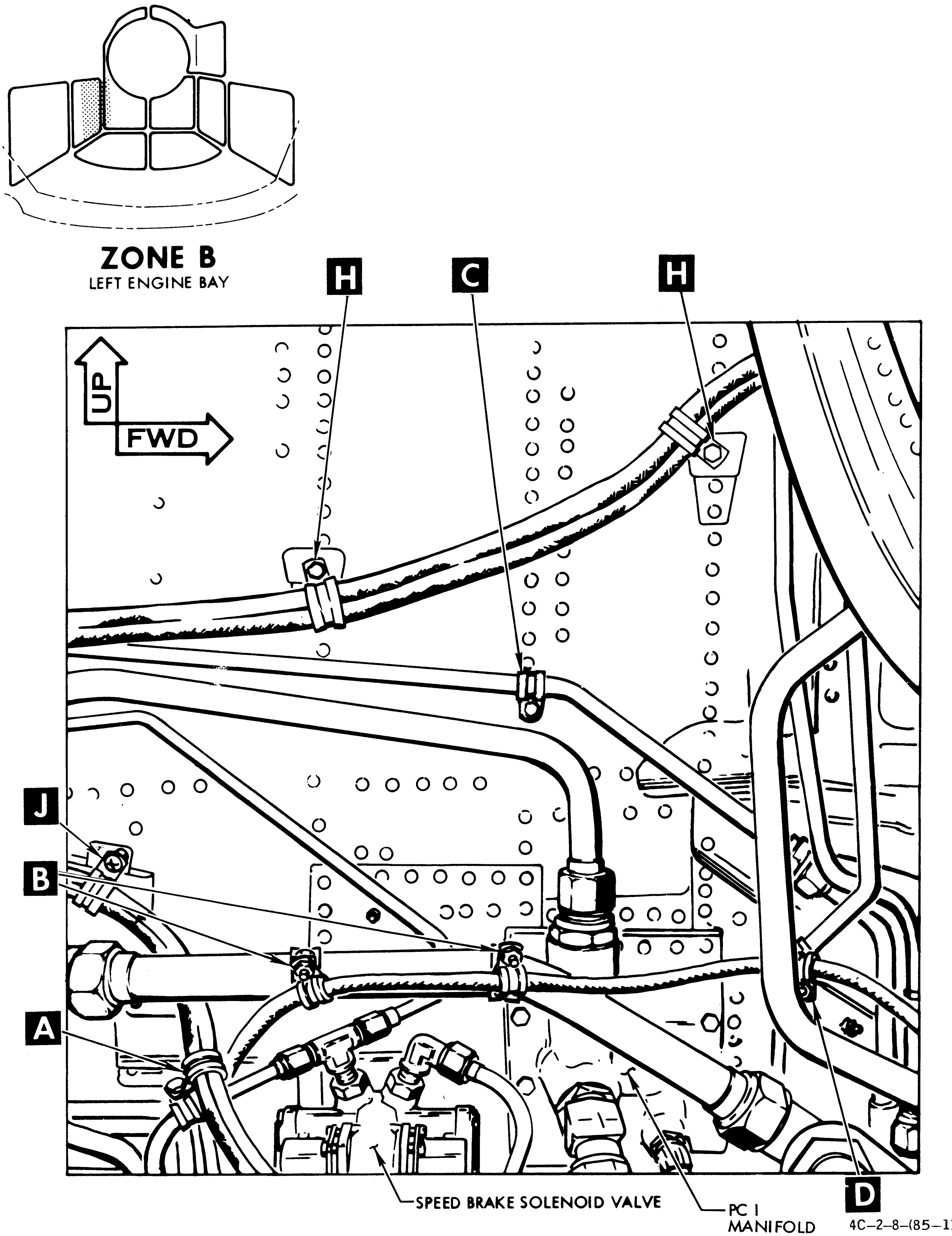
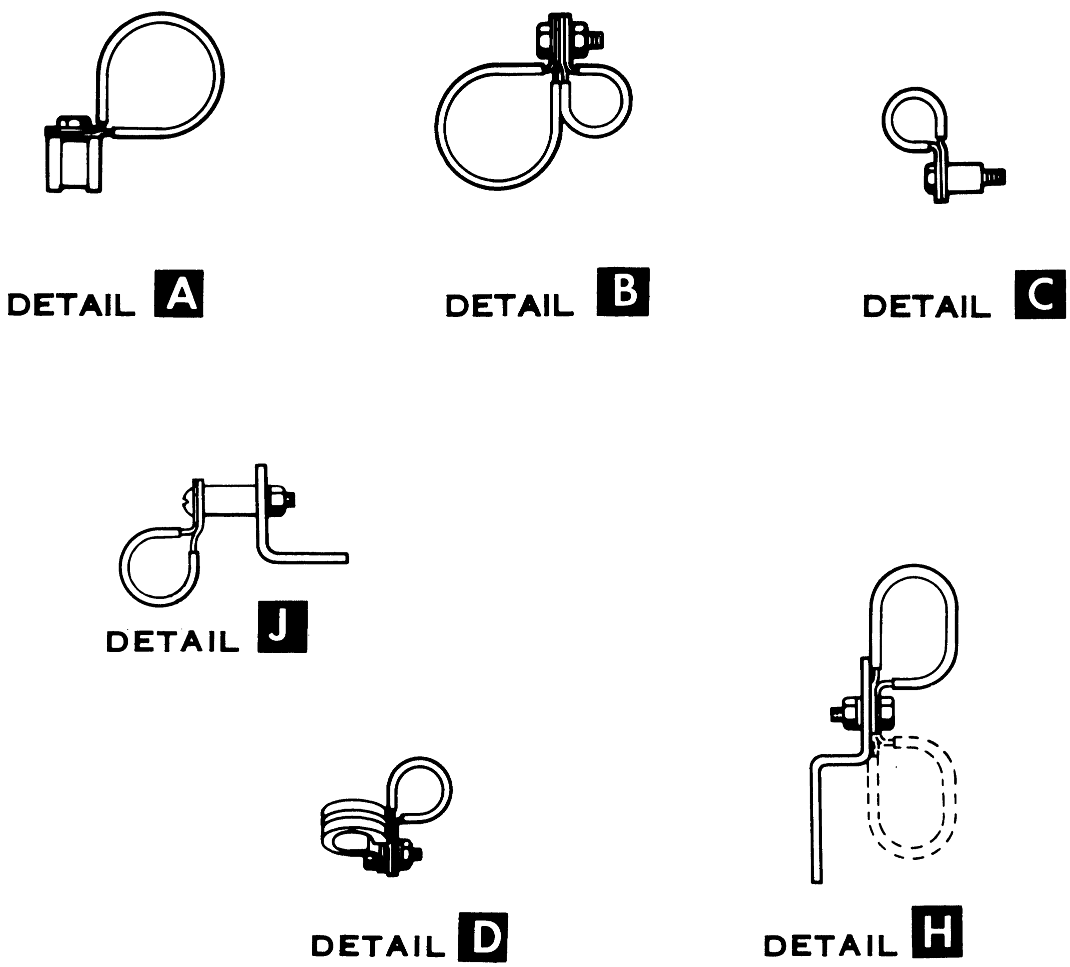


Figure 14-4. Left Engine Bay Zone B (Sheet 1 of 4)

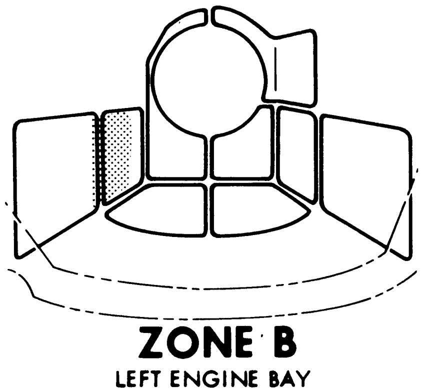
NOTE

1 POSITION CLAMP FOR BEST WIRE BUNDLE ROUTING.



4C-2-8-(85-2)

Figure 14-4. Left Engine Bay Zone B (Sheet 2 of 4)



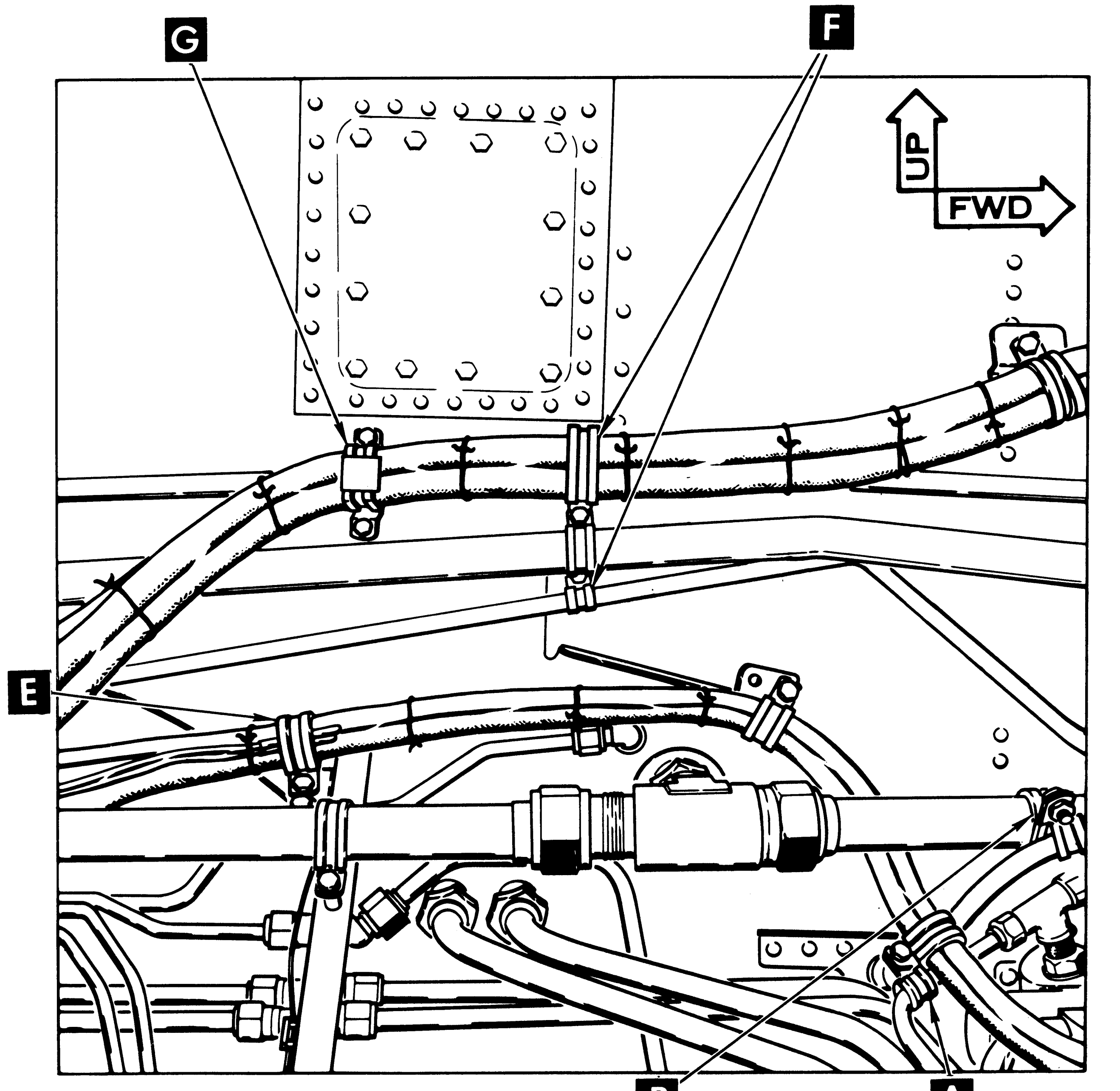
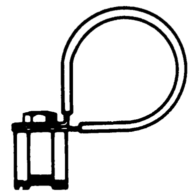
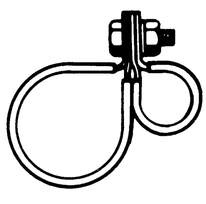


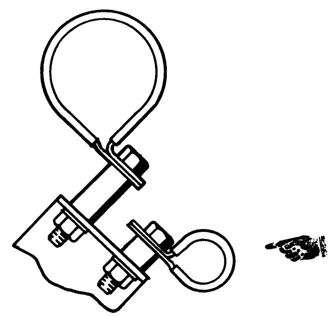
Figure 14-4. Left Engine Bay Zone B (Sheet 3 of 4)



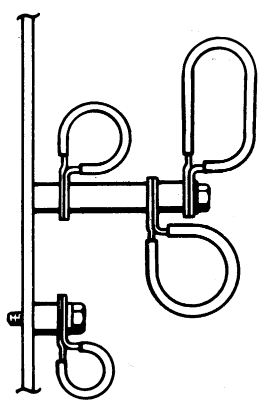
DETAIL A



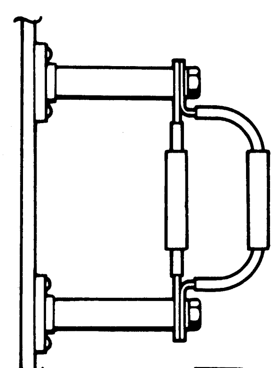
DETAIL B



DETAIL E



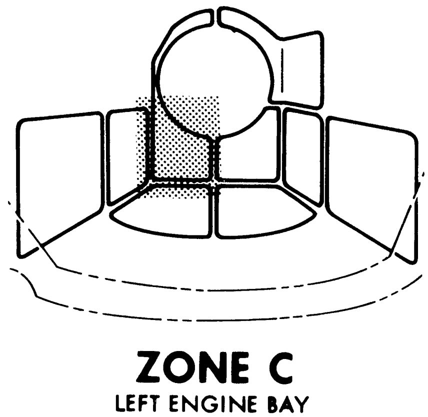
DETAIL F



DETAIL G

4C-2-8-(85-4)A

Figure 14-4. Left Engine Bay Zone B (Sheet 4 of 4)



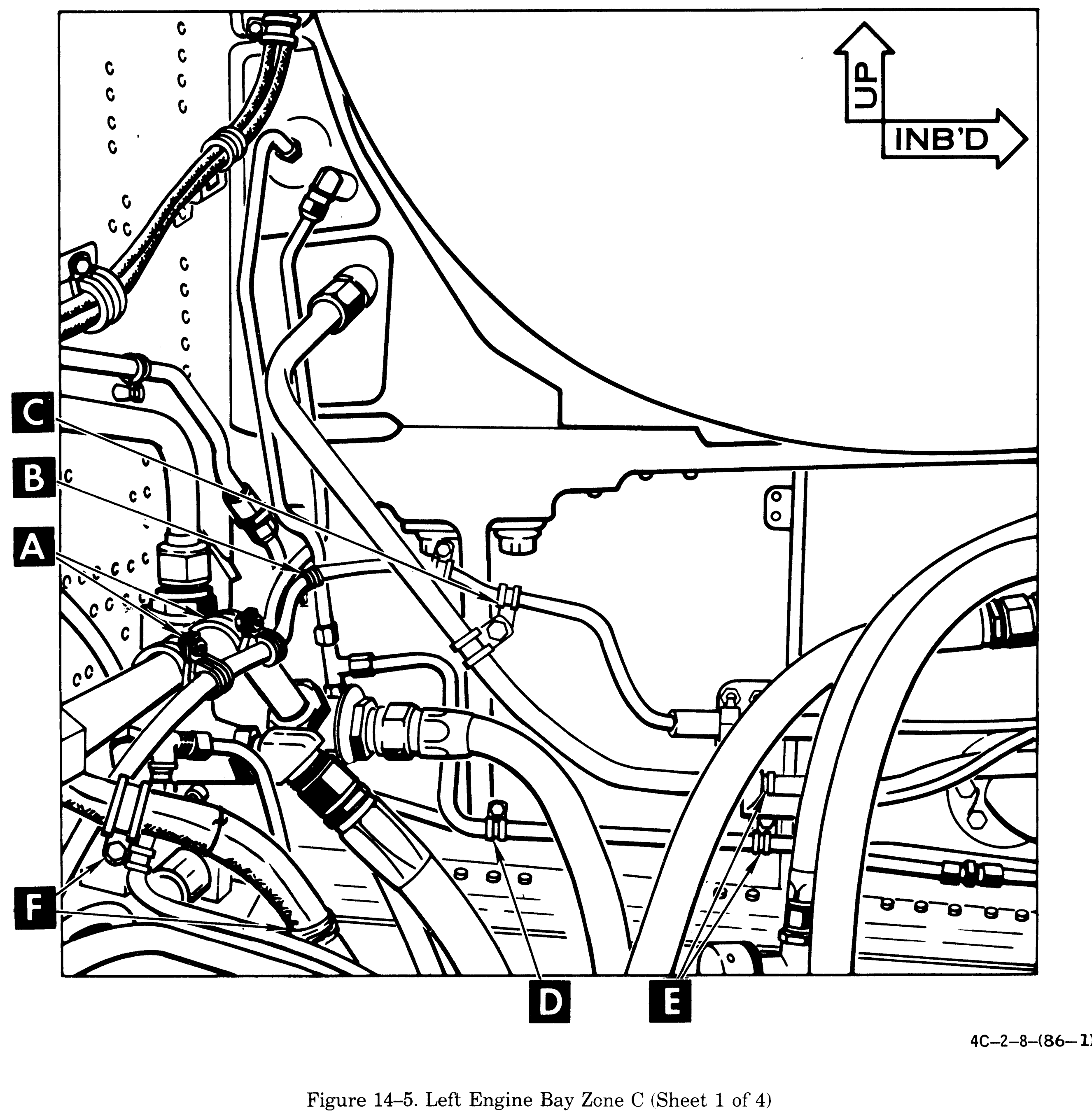


Figure 14-5. Left Engine Bay Zone C (Sheet 1 of 4)

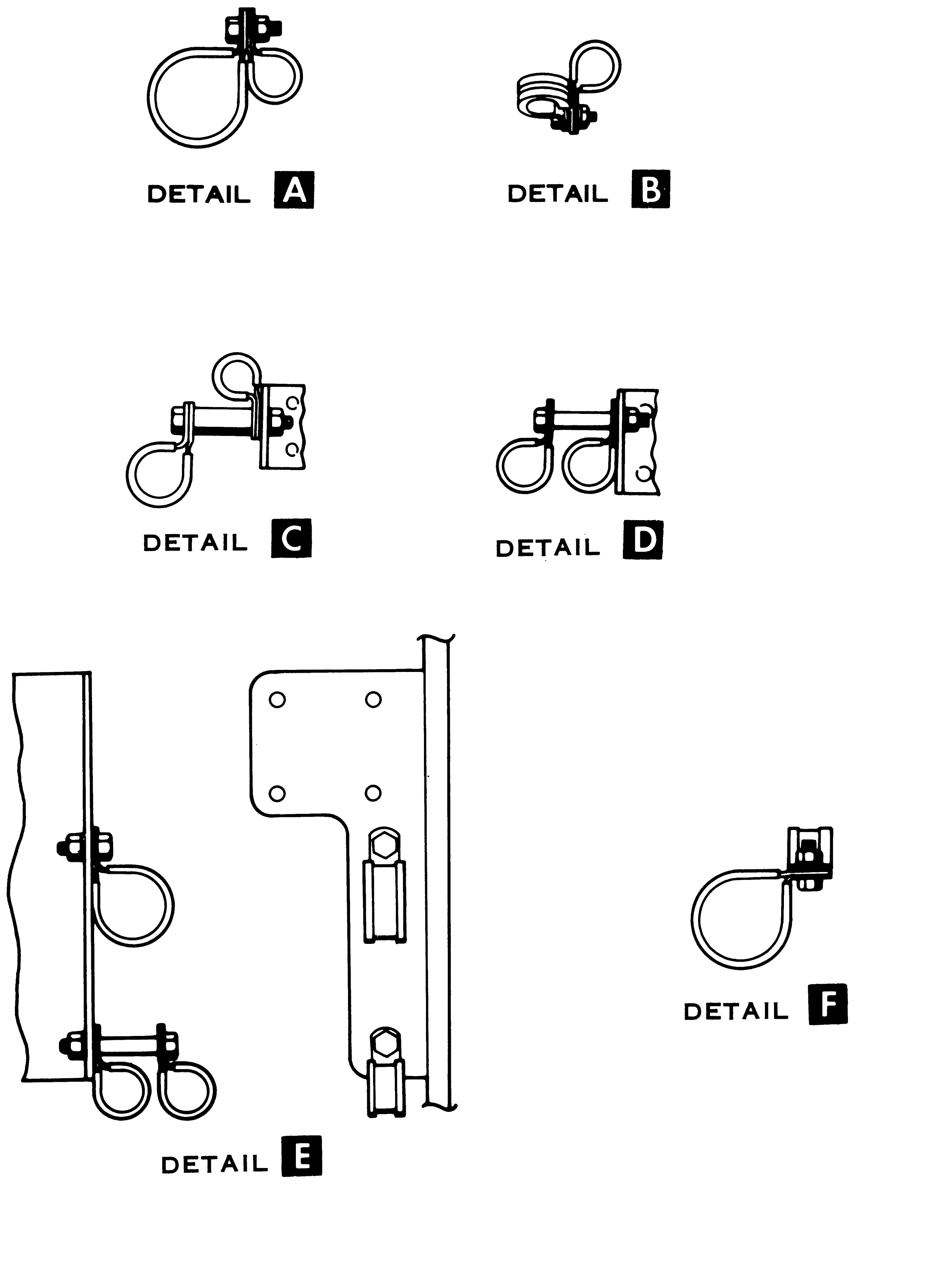


Figure 14-5. Left Engine Bay Zone C (Sheet 2 of 4)

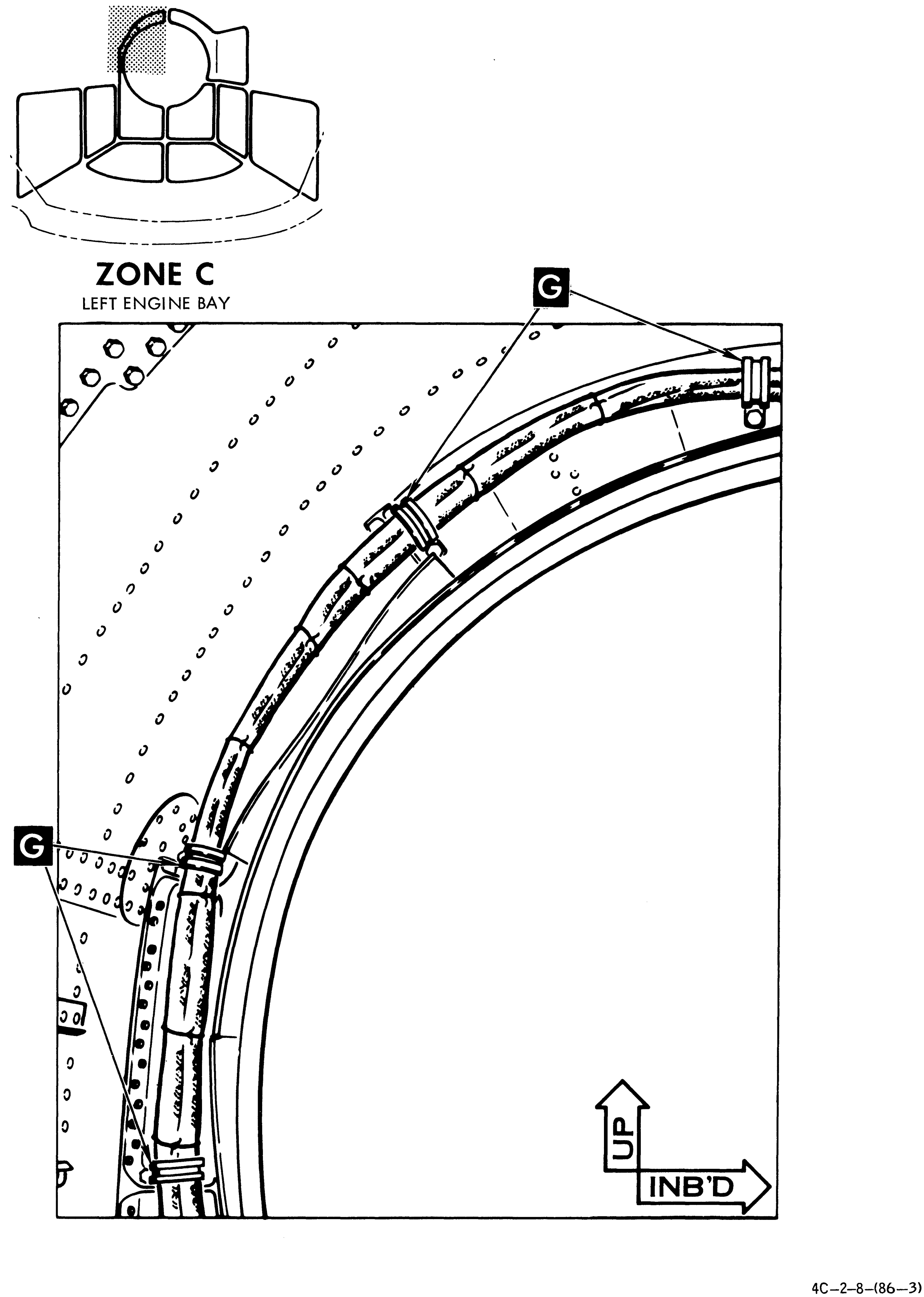
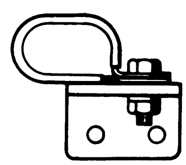
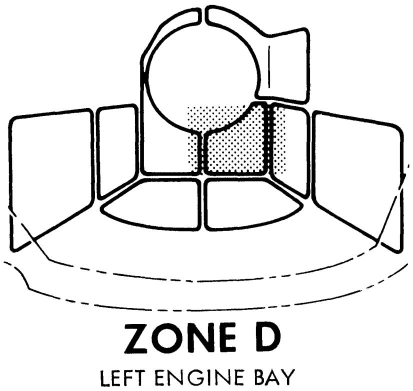


Figure 14-5. Left Engine Bay Zone C (Sheet 3 of 4)



4C-2-8-(86-4)

Figure 14-5. Left Engine Bay Zone C (Sheet 4 of 4)



CRITICAL INFORMATION			
INDEX	MINIMUM CLEARANCE	ANGLE	DESCRIPTION
1	1		HYDRAULIC PRESSURE SWITCH WIRING
2	2		WIRE BUNDLE TO HYDRAULIC TUBE

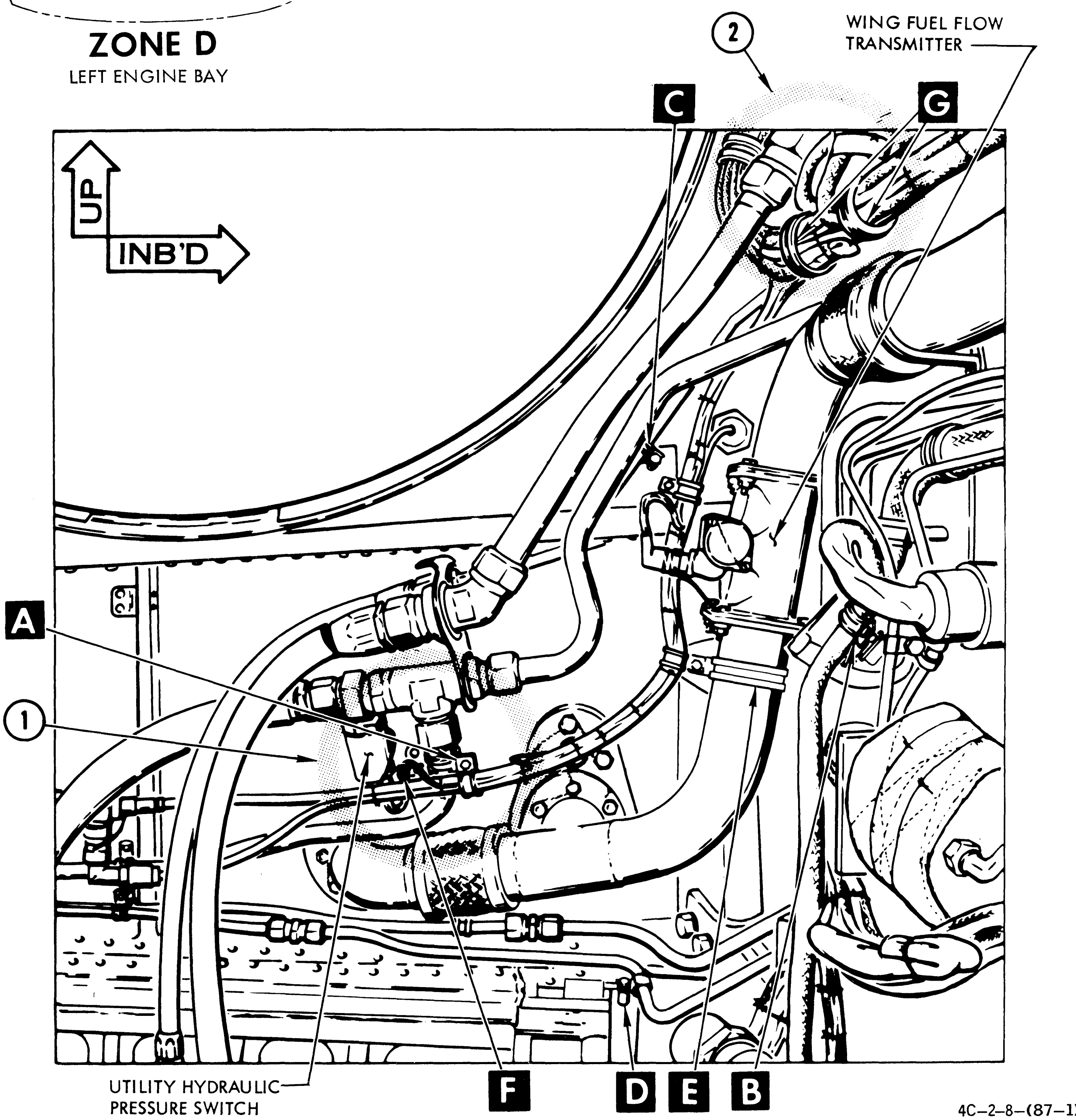


Figure 14-6. Left Engine Bay Zone D - BEFORE T.O.1F-4C-598 (Sheet 1 of 2)

NOTES

1 REPOSITION WIRE BUNDLE IF CHAFE CONDITION EXISTS BETWEEN STRUCTURE OR HYDRAULIC LINE.

2 POSITION WIRE BUNDLE TO MAINTAIN 1/4 INCH MINIMUM CLEARANCE BETWEEN BUNDLE AND HYDRAULIC LINES. BUNDLE CLAMP CAN BE BENT UP TO 45° MAXIMUM TO ATTAIN CLEARANCE.

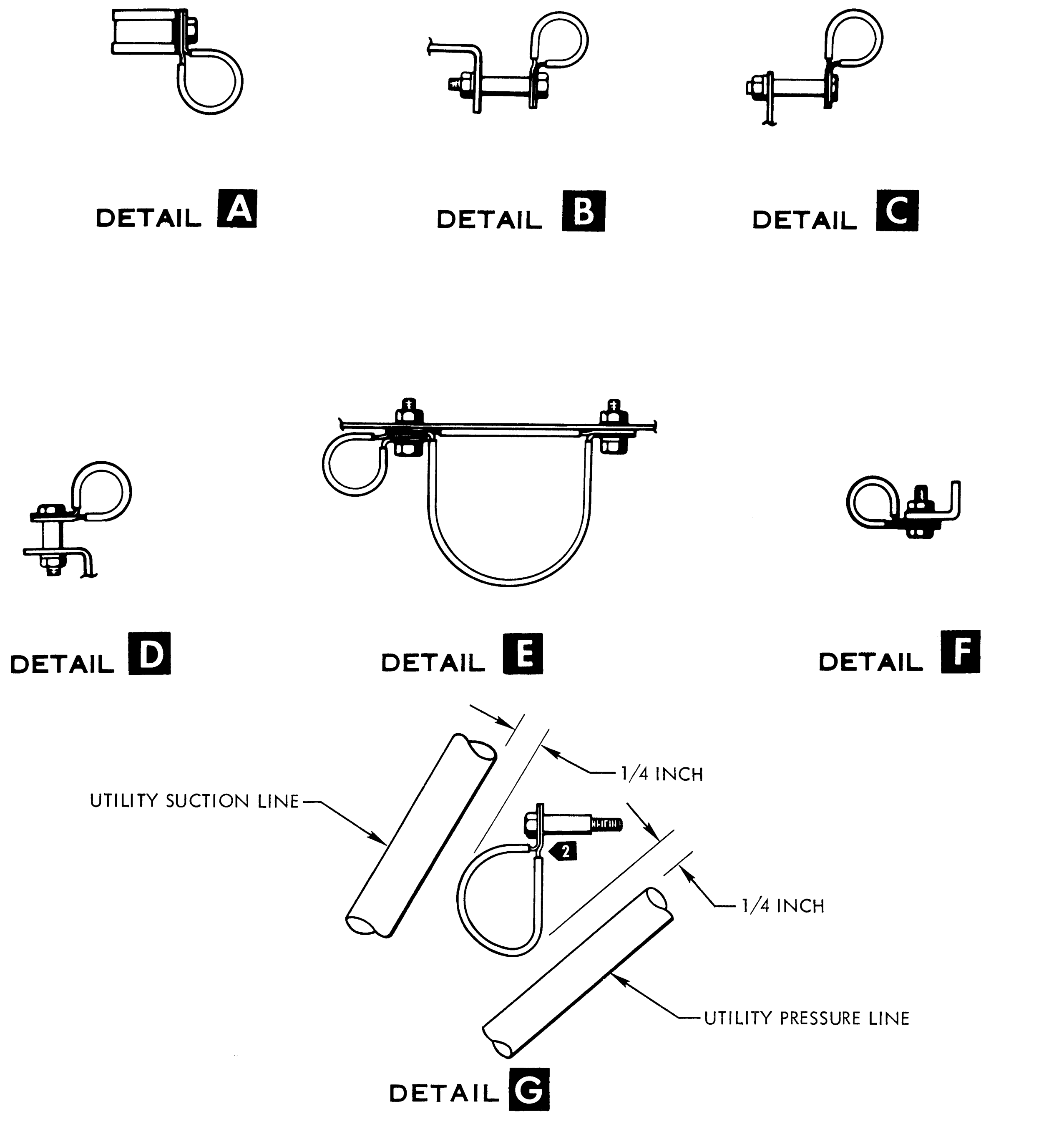
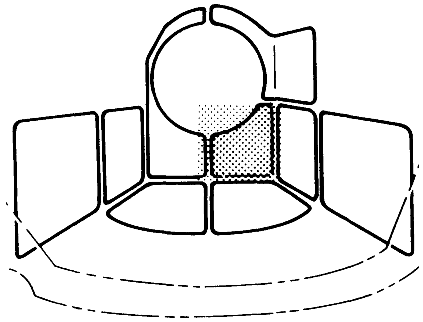


Figure 14-6. Left Engine Bay Zone D – BEFORE T.O.1F-4C-598 (Sheet 2 of 2)



ZONE D
LEFT ENGINE BAY

CRITICAL INFORMATION			
INDEX	MINIMUM CLEARANCE	ANGLE	DESCRIPTION
1	1		HYDRAULIC PRESSURE SWITCH
2	1		WIRE BUNDLE TO HYDRAULIC TUBE

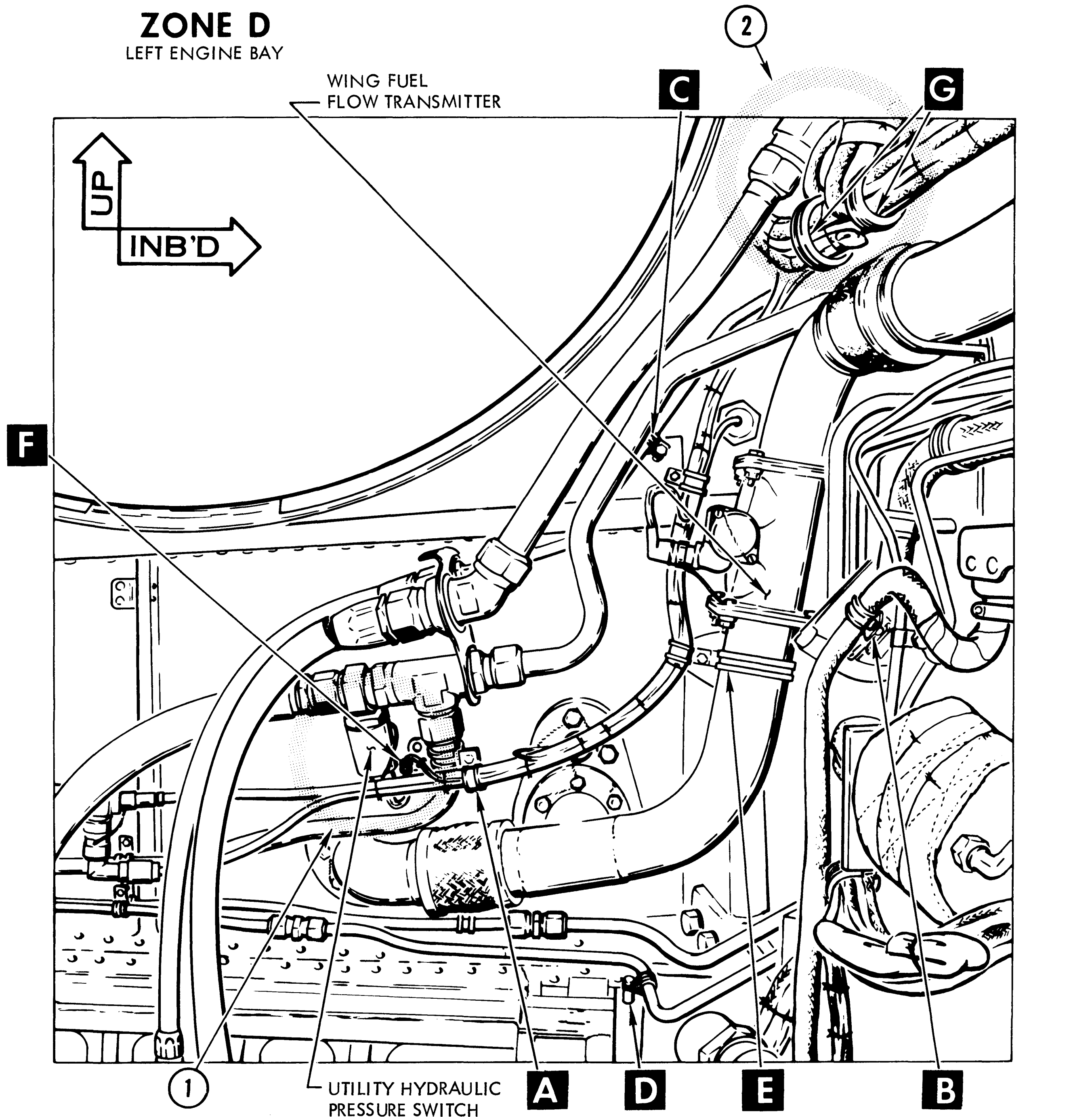
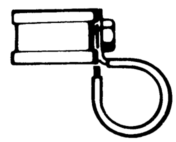


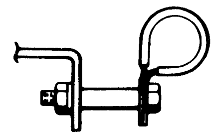
Figure 14-7. Left Engine Bay Zone D - AFTER T.O.1F-4C-598 (Sheet 1 of 2)

NOTE

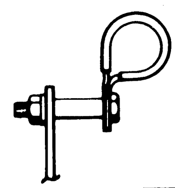
1 REPOSITION WIRE BUNDLE IF CHAFE CONDITION EXIST BETWEEN STRUCTURE OR HYDRAULIC LINE.



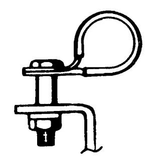
DETAIL A



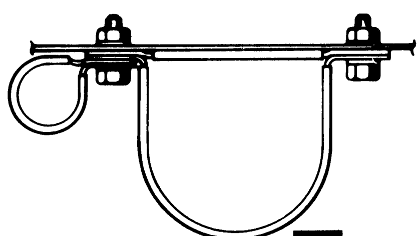
DETAIL B



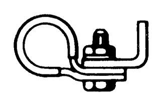
DETAIL C



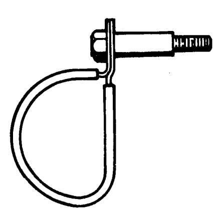
DETAIL D



DETAIL E



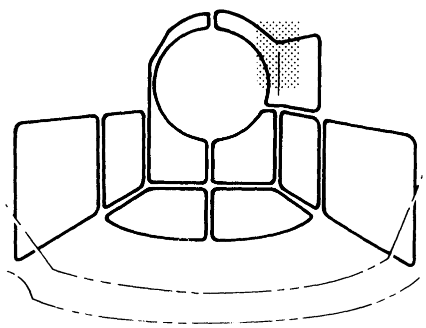
DETAIL F

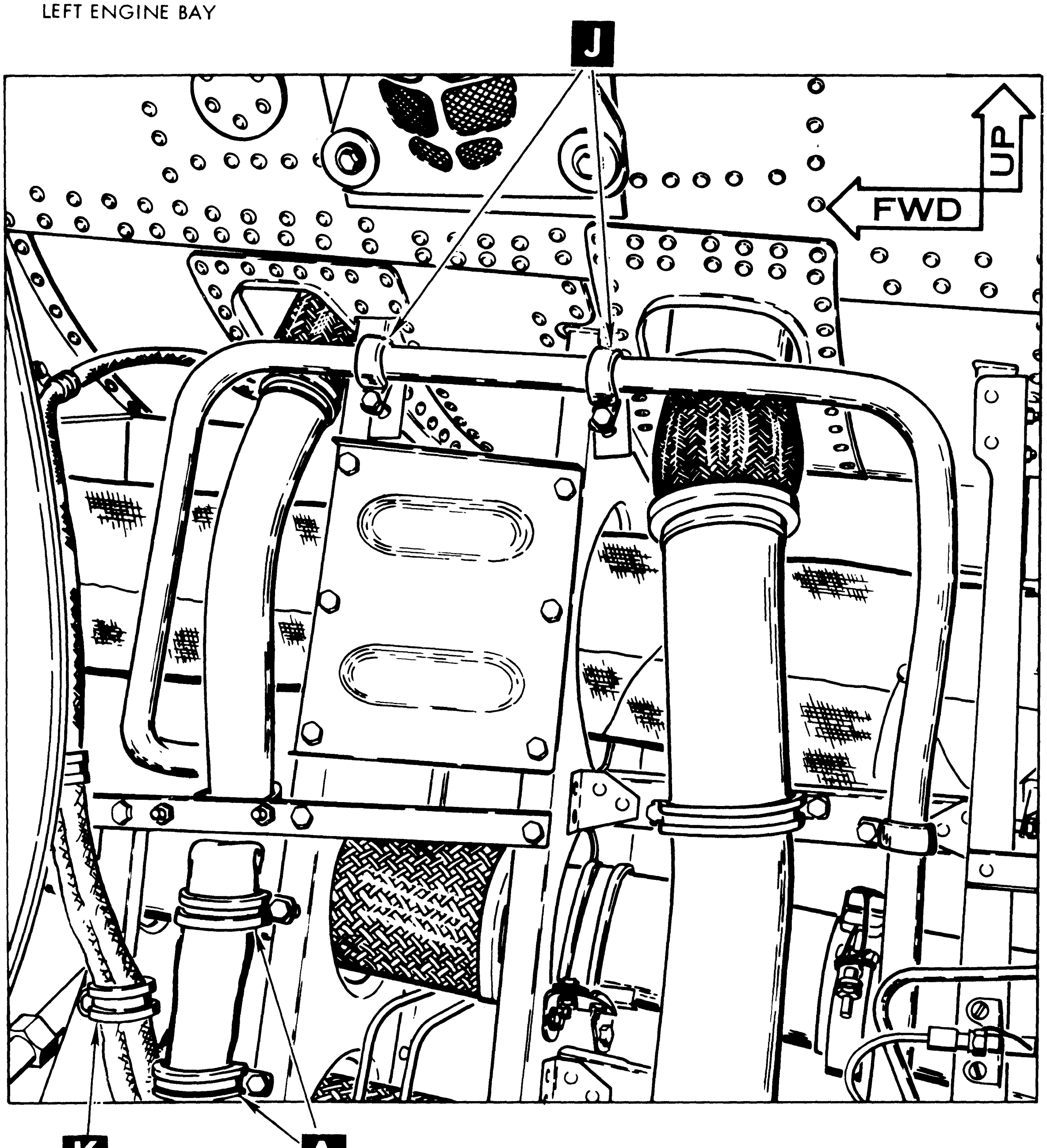


DETAIL G

4C-2-8-(186-2)

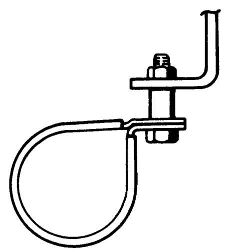
Figure 14-7. Left Engine Bay Zone D - AFTER T.O.1F-4C-598 (Sheet 2 of 2)



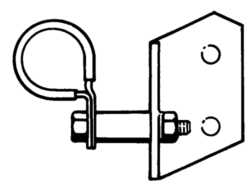


4C-2-8-(88-1)

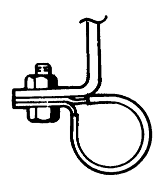
Figure 14-8. Left Engine Bay Zone E - BEFORE T.O.1F-4C-598 (Sheet 1 of 6)



DETAIL A



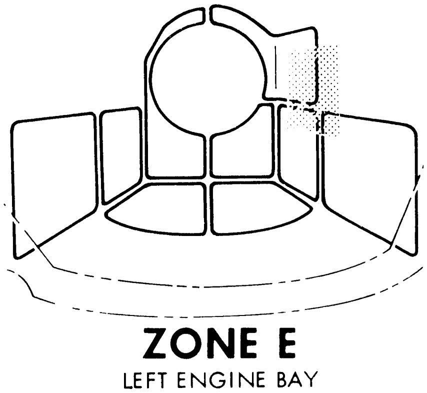
DETAIL J



DETAIL K

4C-2-8-(88-2)

Figure 14-8. Left Engine Bay Zone E - BEFORE T.O.1F-4C-598 (Sheet 2 of 6)



CRITICAL INFORMATION			
INDEX	MINIMUM CLEARANCE	ANGLE	DESCRIPTION
1	1		FUEL MANIFOLD COUPLING

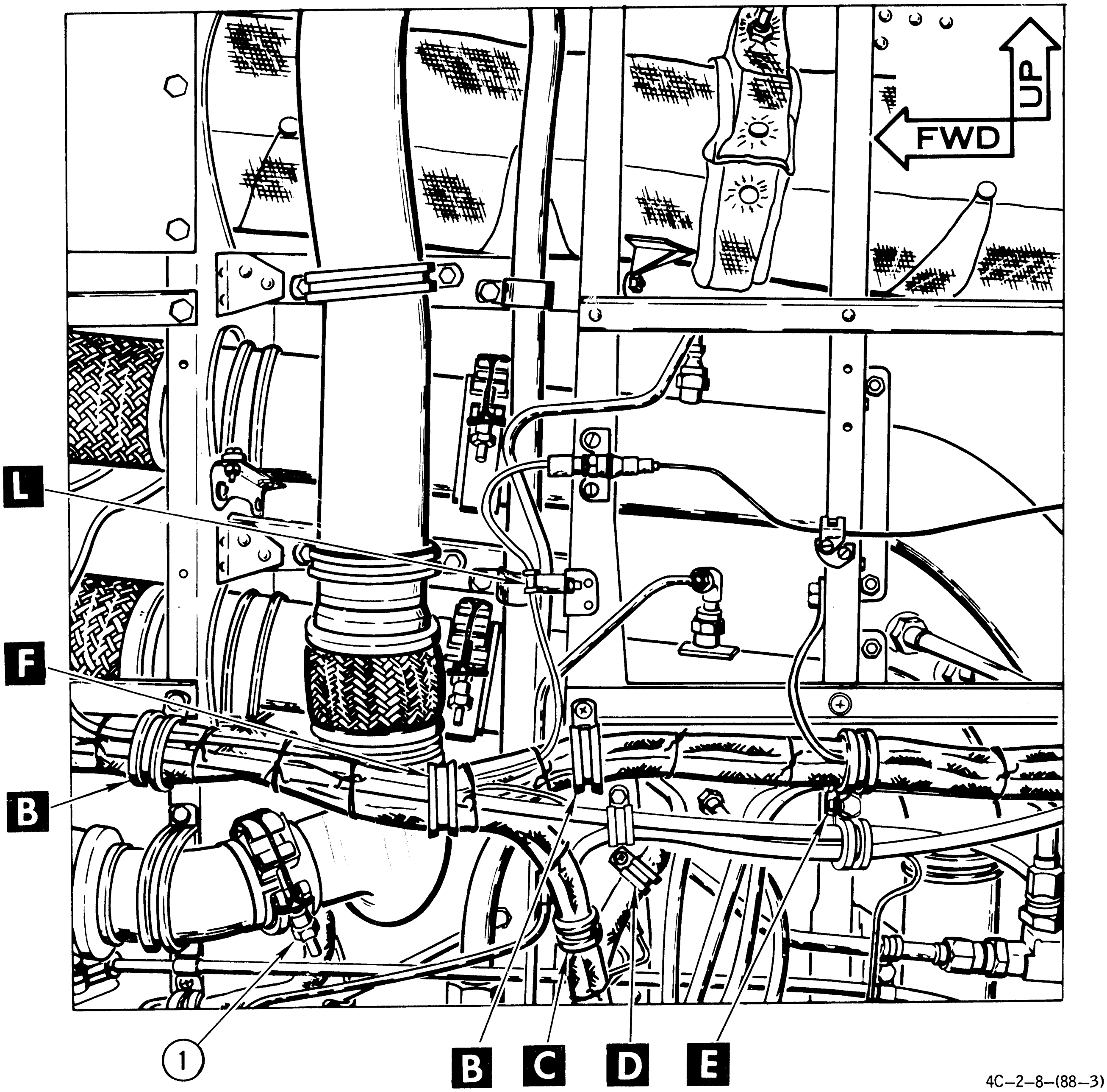
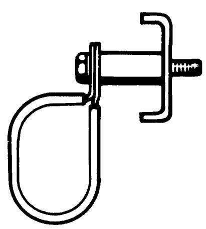


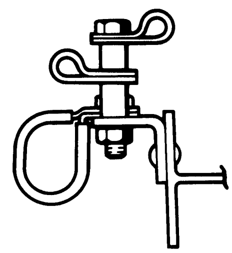
Figure 14–8. Left Engine Bay Zone E – BEFORE T.O.1F–4C–598 (Sheet 3 of 6)

NOTE

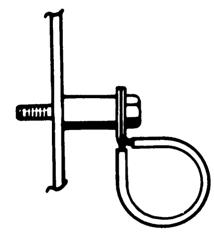
1 COUPLING ON MANIFOLD MUST BE AS SHOWN TO PREVENT WIRE BUNDLE CHAFING.



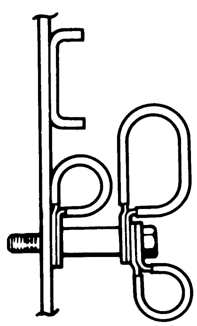
DETAIL B



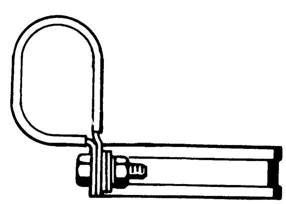
DETAIL C



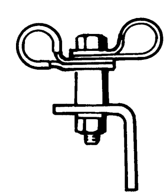
DETAIL D



DETAIL E



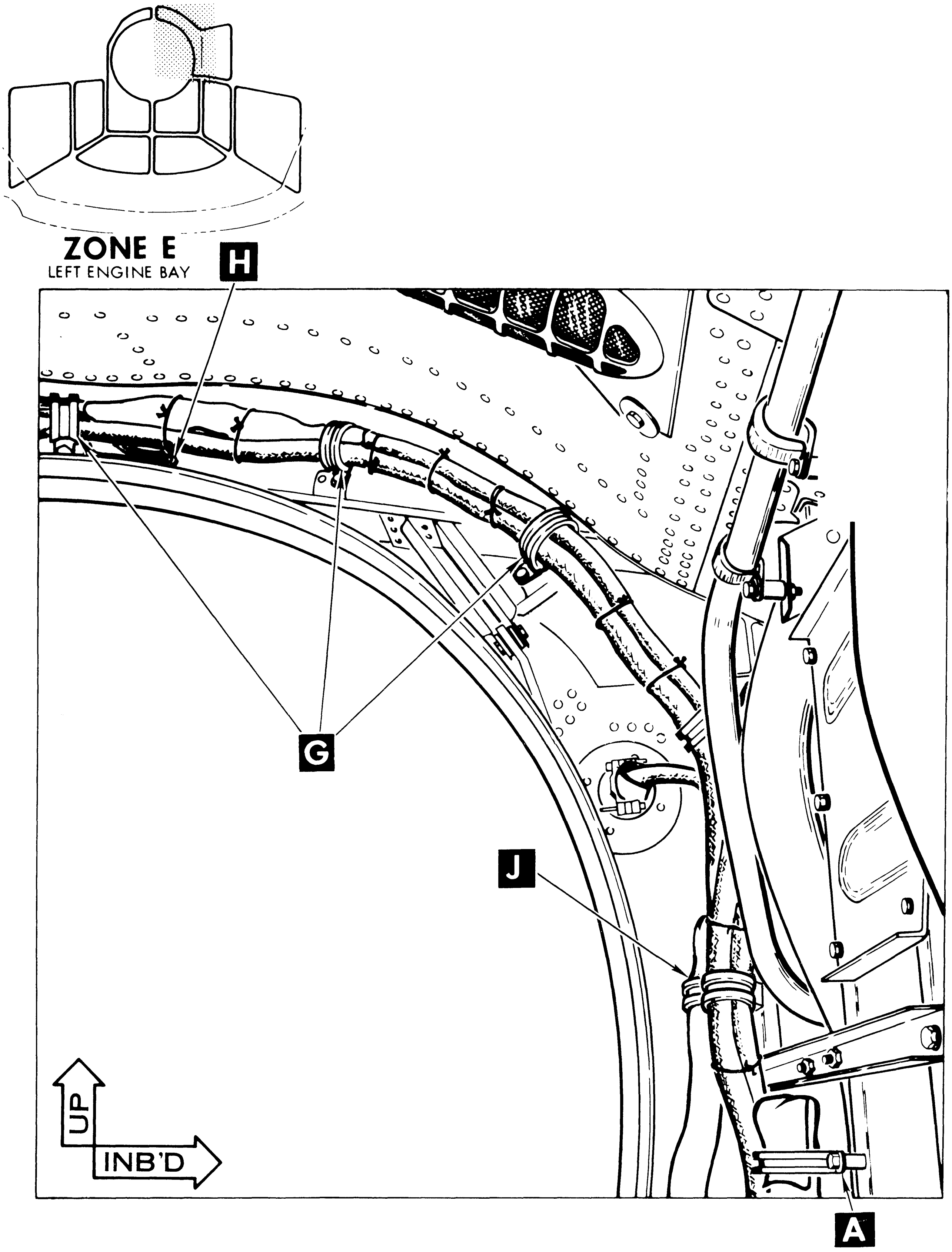
DETAIL F



DETAIL L

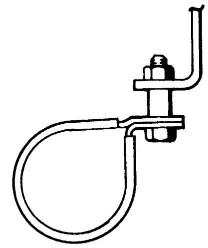
4C–2–8–(88–4)

Figure 14–8. Left Engine Bay Zone E – BEFORE T.O.1F–4C–598 (Sheet 4 of 6)

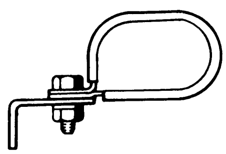


4C-2-8-(88-5)

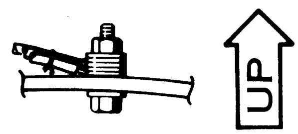
Figure 14-8. Left Engine Bay Zone E - BEFORE T.O.1F-4C-598 (Sheet 5 of 6)



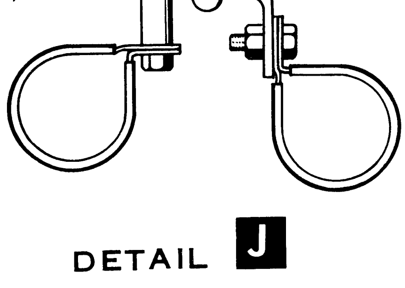
DETAIL A



DETAIL G



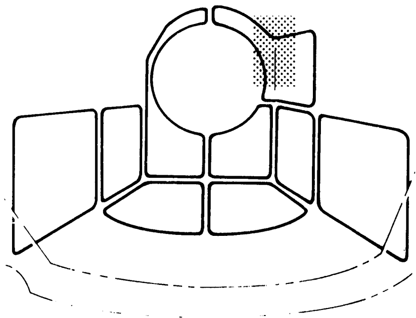
DETAIL H

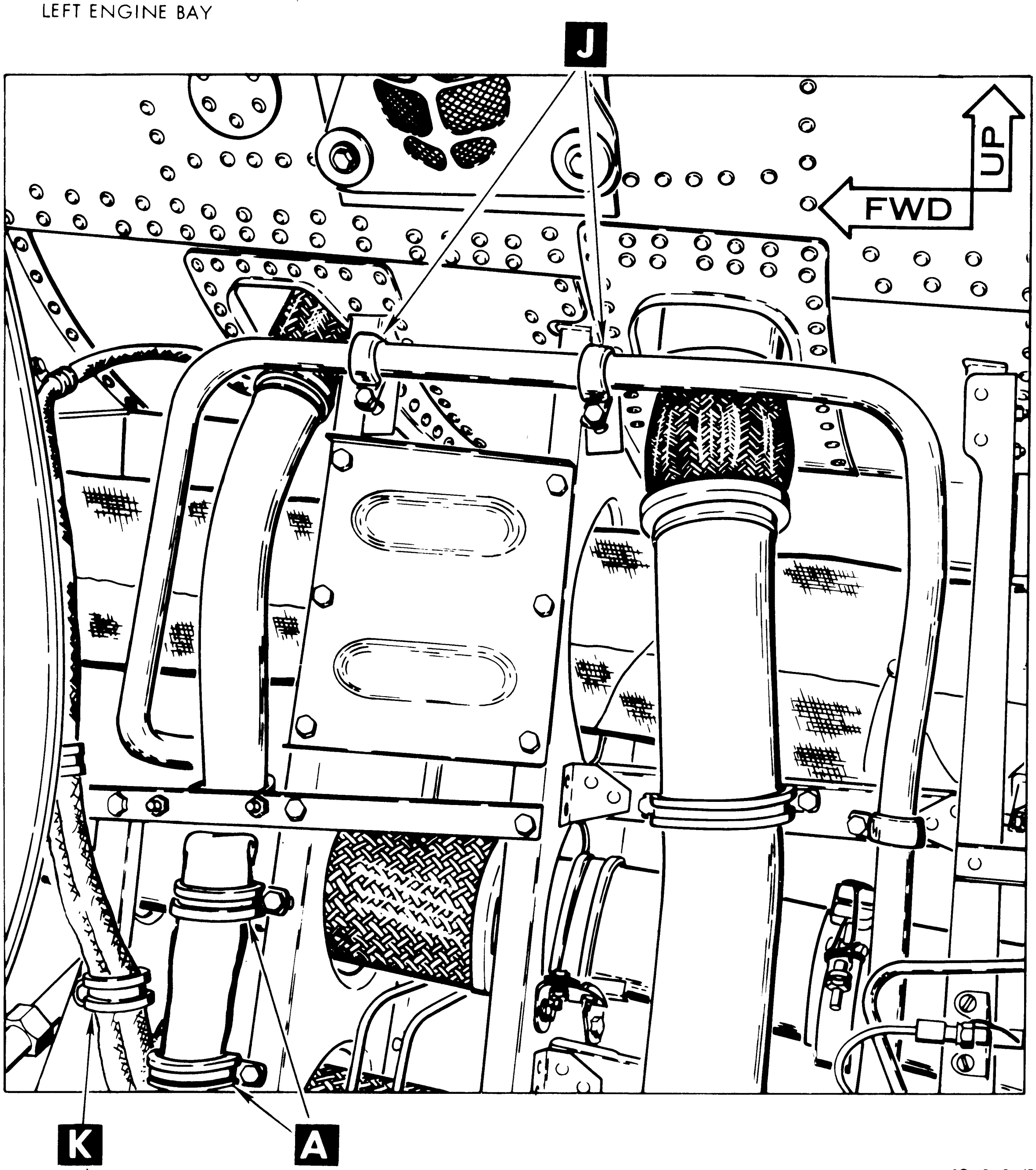


DETAIL J

4C-2-8-(88-6)

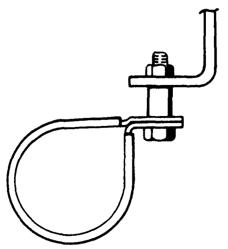
Figure 14-8. Left Engine Bay Zone E - BEFORE T.O.1F-4C-598 (Sheet 6 of 6)



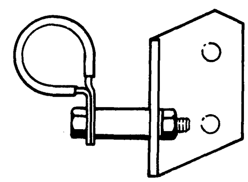


4C-2-8-(185-1)

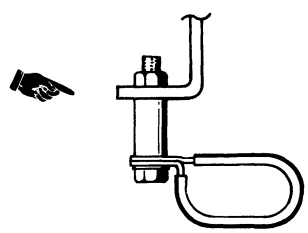
Figure 14-9. Left Engine Bay Zone E - AFTER T.O.1F-4C-598 (Sheet 1 of 6)



DETAIL **A**



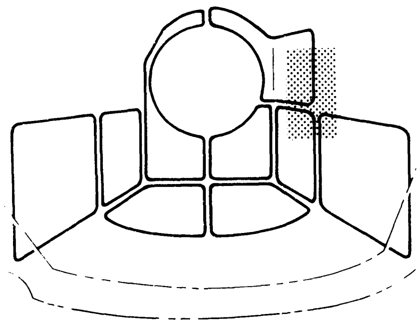
DETAIL **J**



DETAIL **K**

4C–2–8–(185–2) A

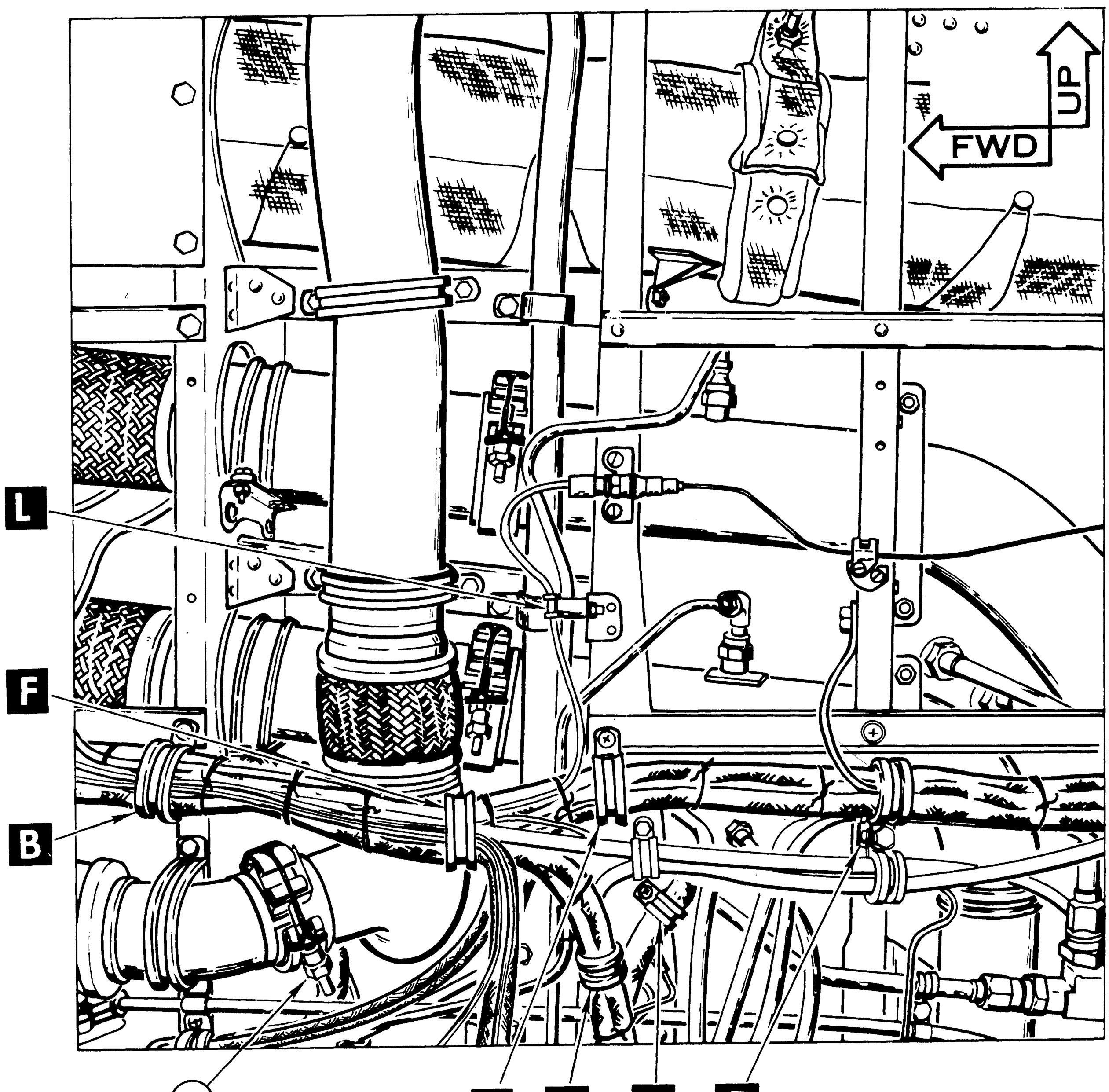
Figure 14–9. Left Engine Bay Zone E – AFTER T.O.1F–4C–598 (Sheet 2 of 6)



ZONE E

LEFT ENGINE BAY

CRITICAL INFORMATION			
INDEX	MINIMUM CLEARANCE	ANGLE	DESCRIPTION
1	1		FUEL MANIFOLD COUPLING

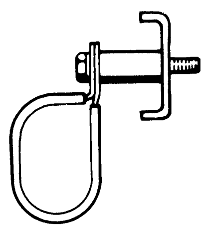


4C-2-8-(185-3)

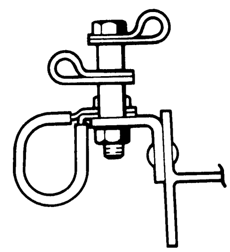
Figure 14-9. Left Engine Bay Zone E – AFTER T.O.1F-4C-598 (Sheet 3 of 6)

NOTE

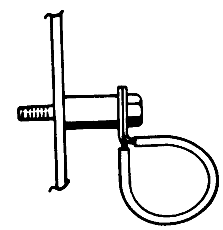
1 COUPLING ON MANIFOLD MUST BE AS SHOWN TO PREVENT WIRE BUNDLE CHAFING.



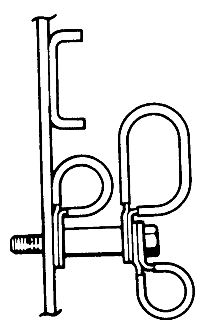
DETAIL B



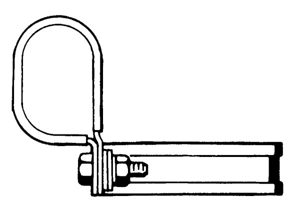
DETAIL C



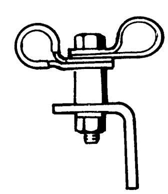
DETAIL D



DETAIL E



DETAIL F



DETAIL L

4C-2-8-(185-4)

Figure 14-9. Left Engine Bay Zone E - AFTER T.O.1F-4C-598 (Sheet 4 of 6)

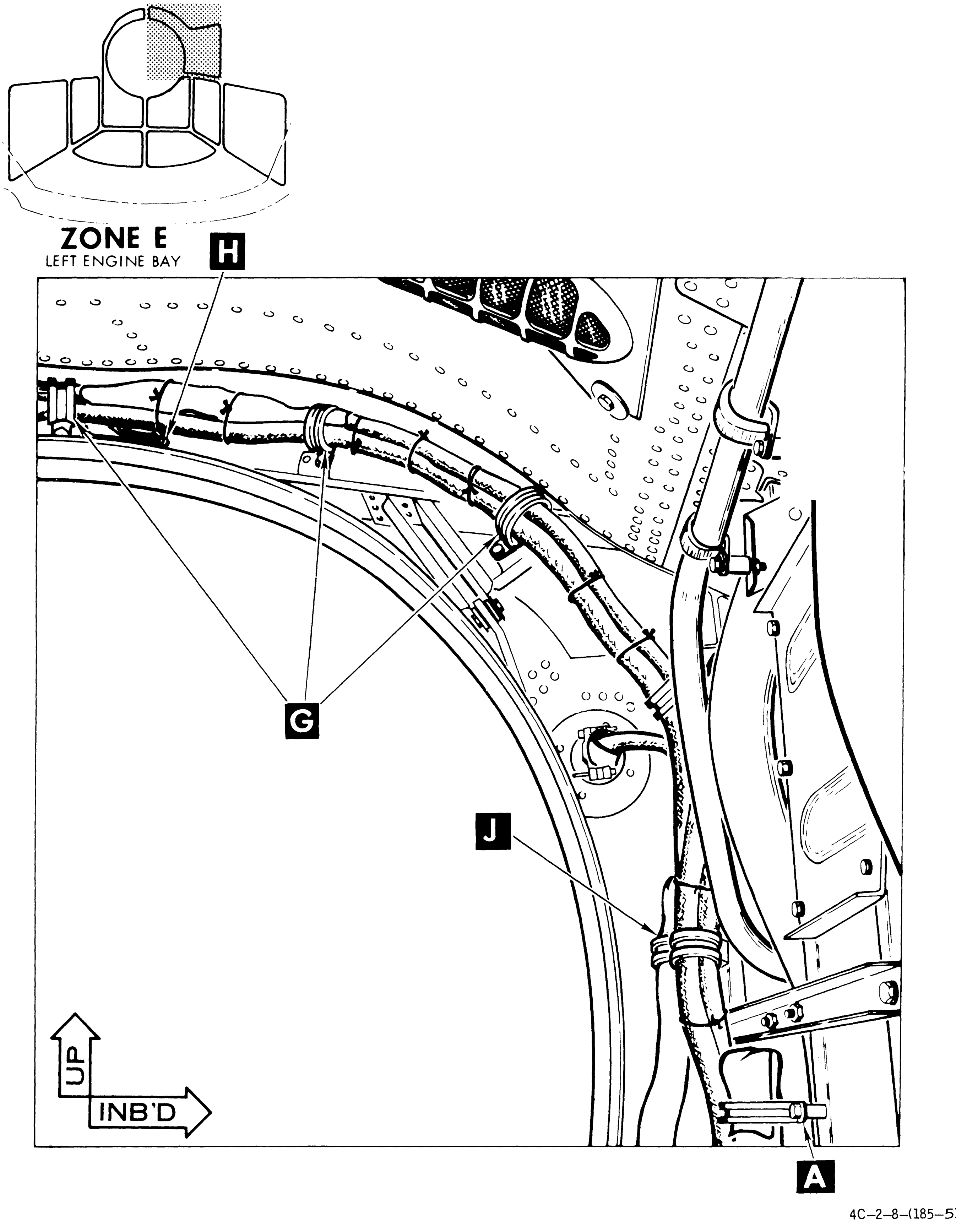
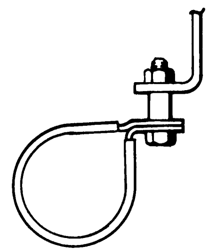
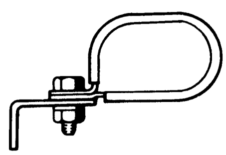


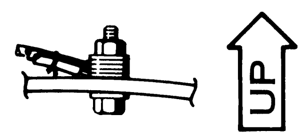
Figure 14-9. Left Engine Bay Zone E – AFTER T.O.1F-4C-598 (Sheet 5 of 6)



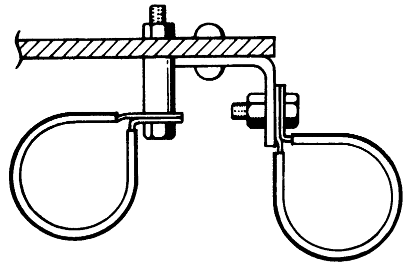
DETAIL A



DETAIL G



DETAIL H



DETAIL J

4C-2-8-(185-6)

Figure 14-9. Left Engine Bay Zone E - AFTER T.O.1F-4C-598 (Sheet 6 of 6)

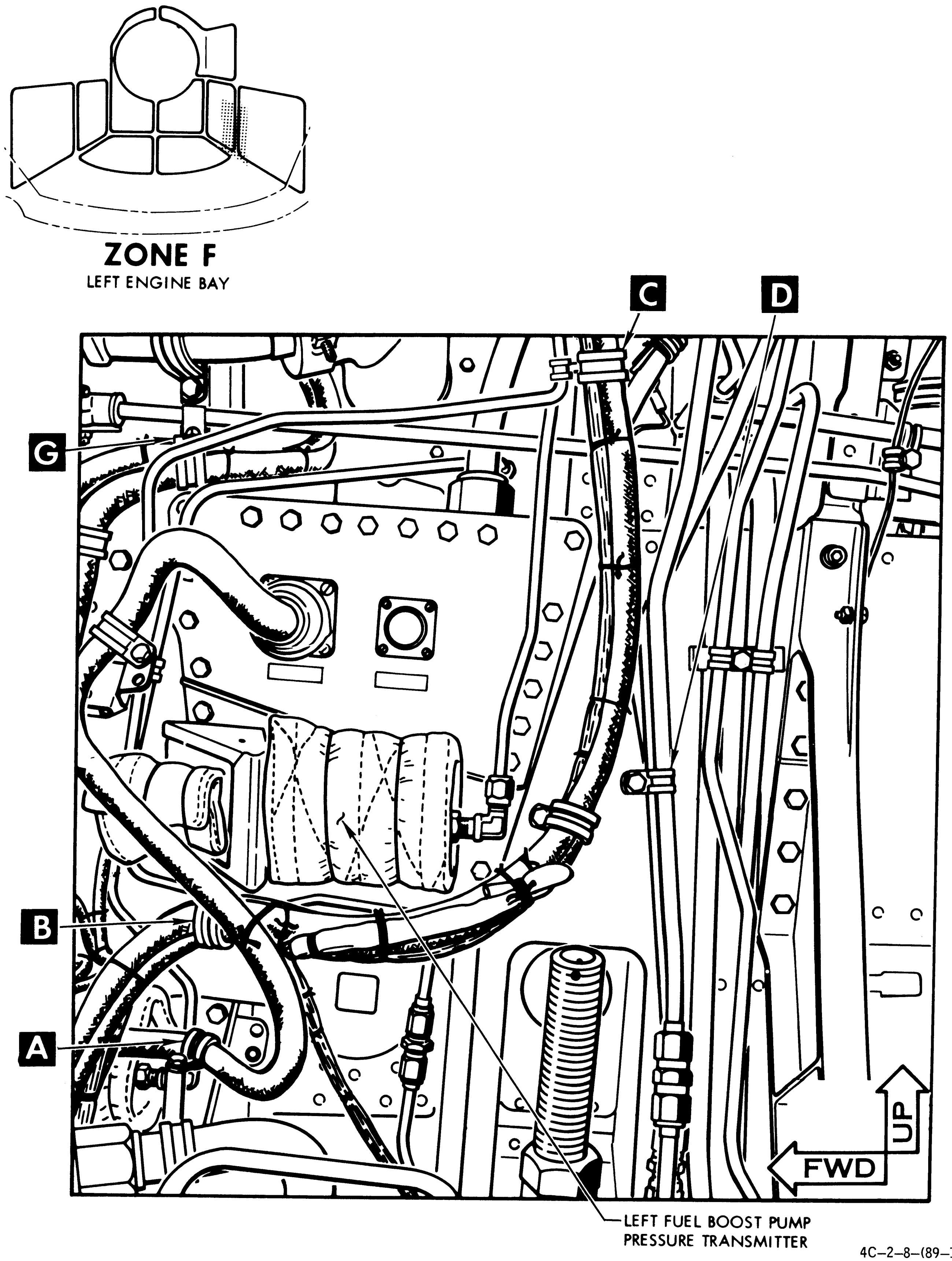
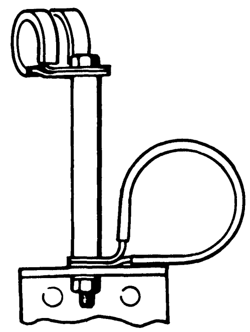
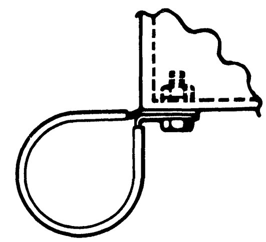


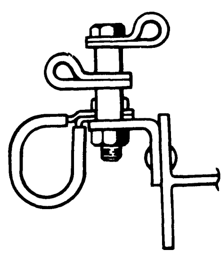
Figure 14-10. Left Engine Bay Zone F - BEFORE T.O.1F-4C-598 (Sheet 1 of 6)



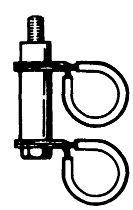
DETAIL **A**



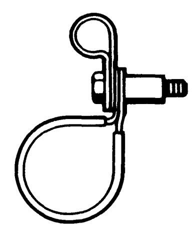
DETAIL **B**



DETAIL **C**



DETAIL **D**



DETAIL **G**

4C-2-8-(89-2)

Figure 14-10. Left Engine Bay Zone F - BEFORE T.O.1F-4C-598 (Sheet 2 of 6)

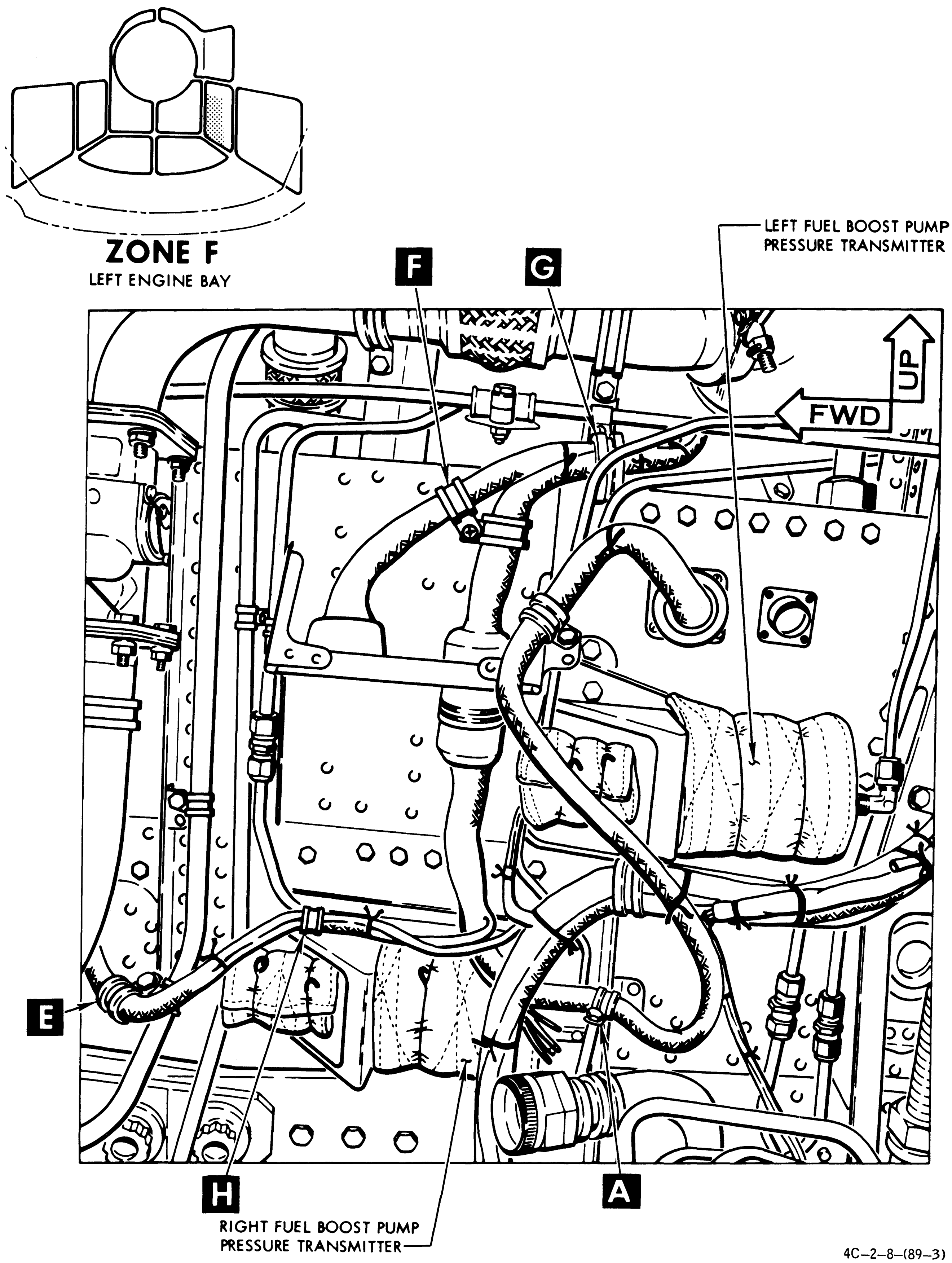


Figure 14-10. Left Engine Bay Zone F - BEFORE T.O.1F-4C-598 (Sheet 3 of 6)

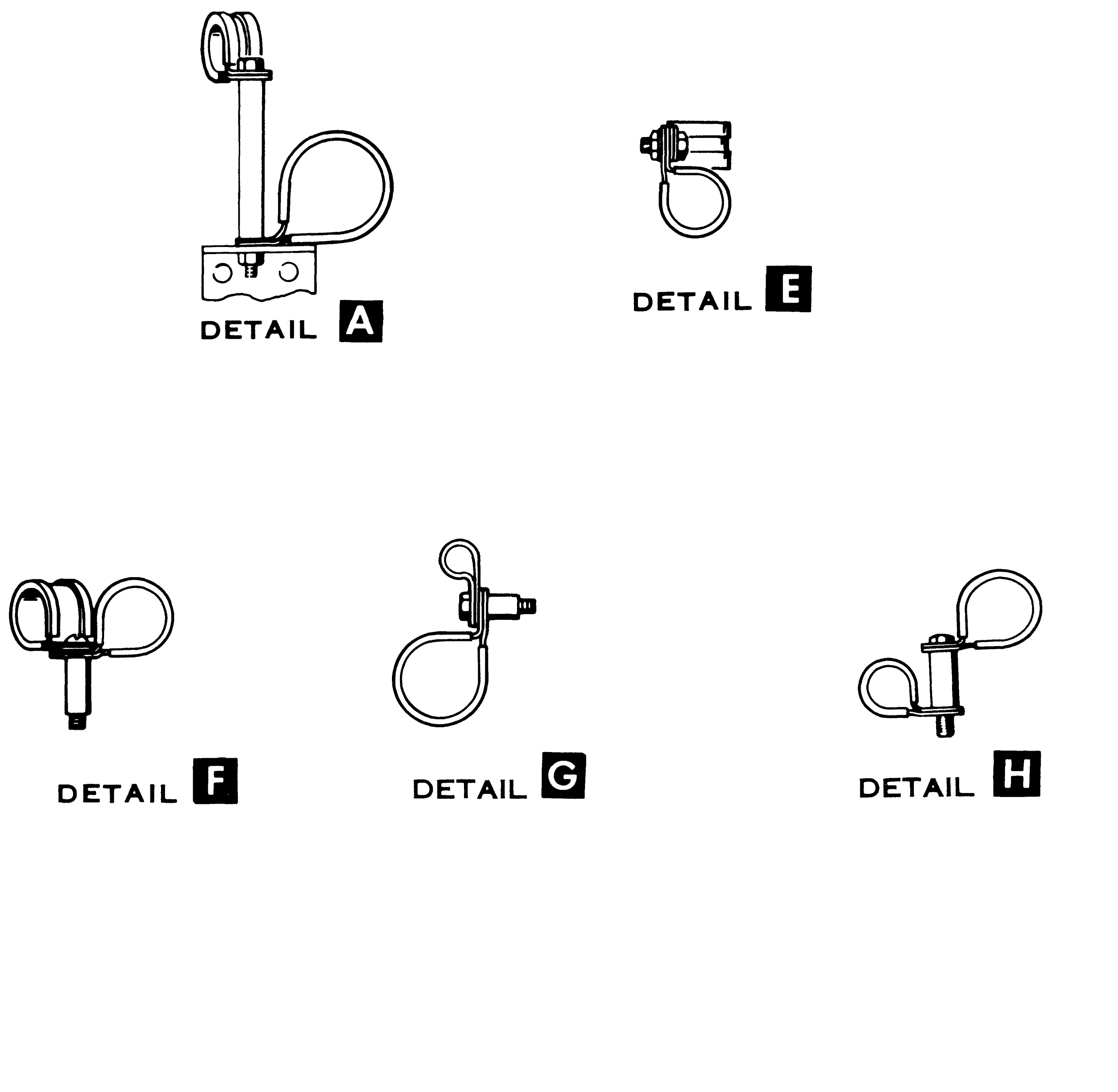


Figure 14-10. Left Engine Bay Zone F - BEFORE T.O.1F-4C-598 (Sheet 4 of 6)

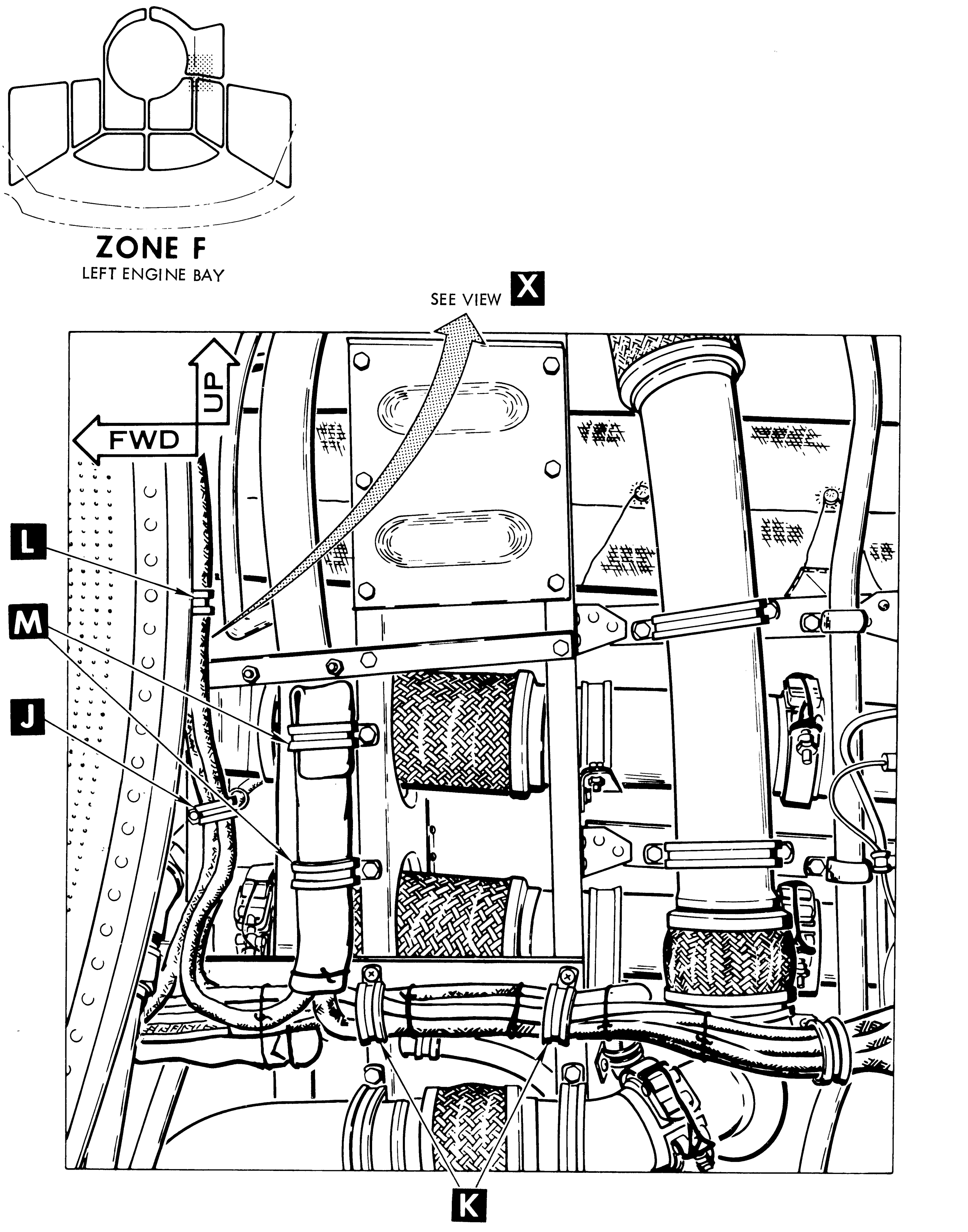


Figure 14-10. Left Engine Bay Zone F - BEFORE T.O.1F-4C-598 (Sheet 5 of 6)

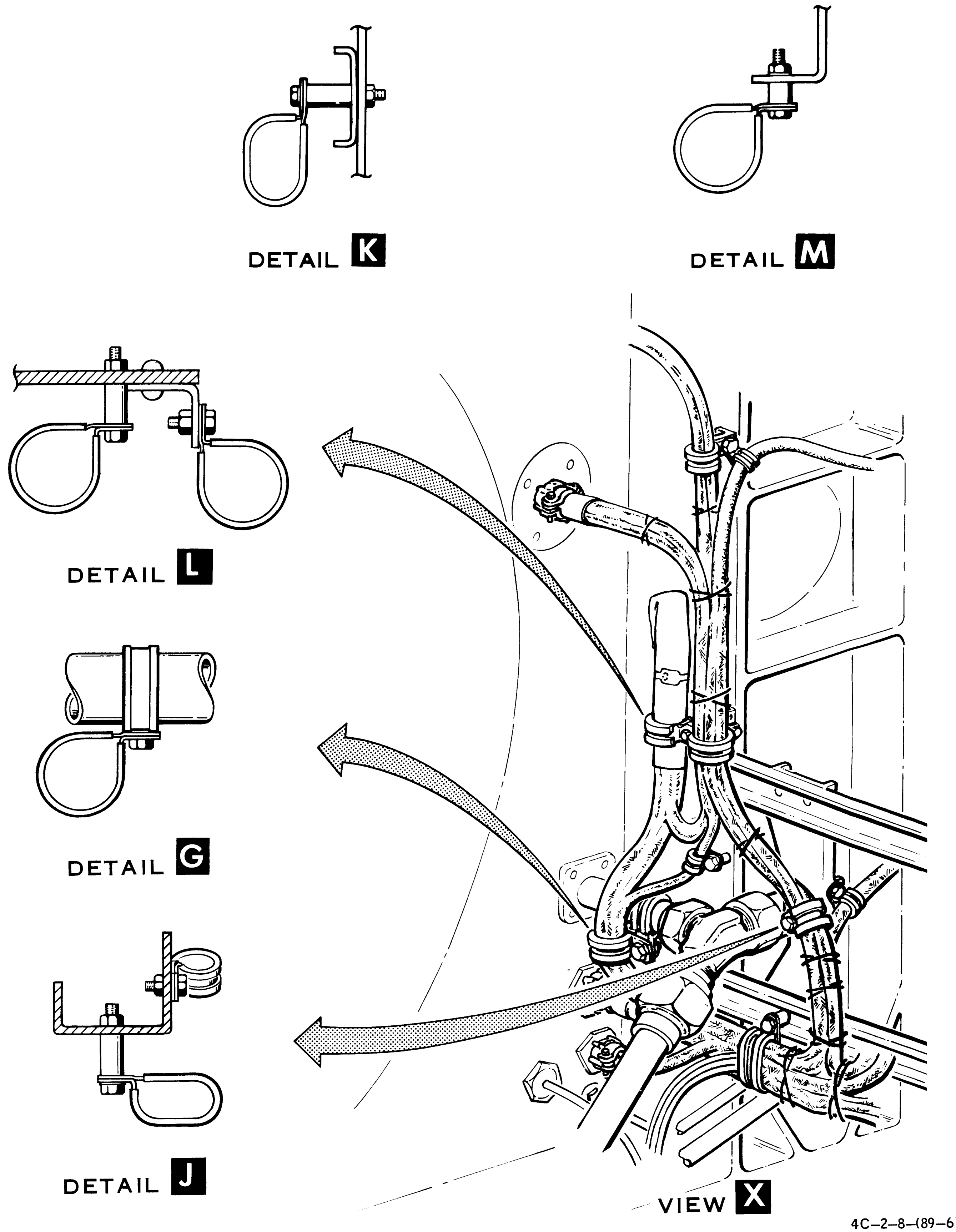
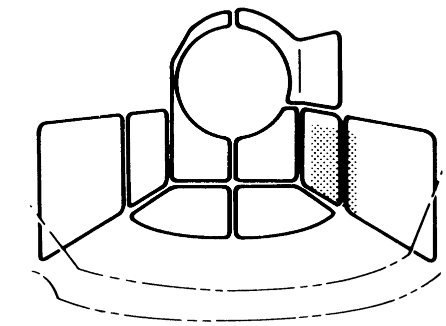


Figure 14-10. Left Engine Bay Zone F - BEFORE T.O.1F-4C-598 (Sheet 6 of 6)



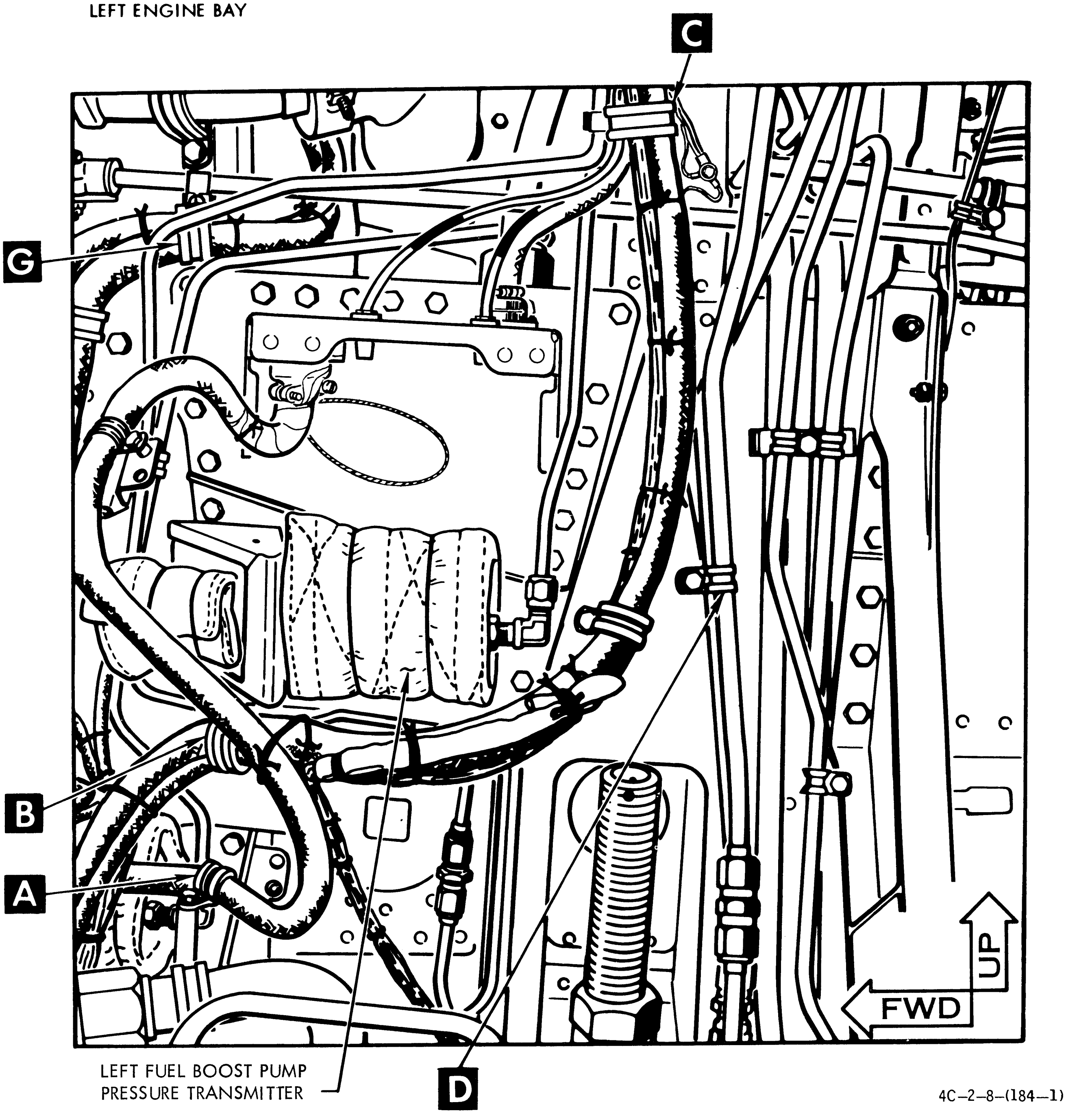
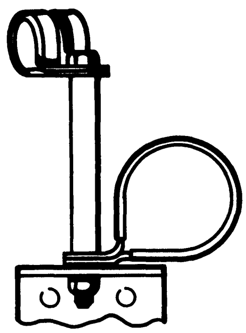
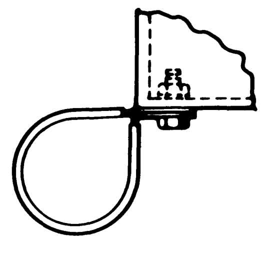


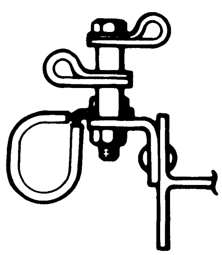
Figure 14-11. Left Engine Bay Zone F - AFTER T.O.1F-4C-598 (Sheet 1 of 6)



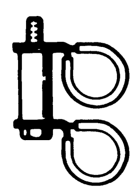
DETAIL **A**



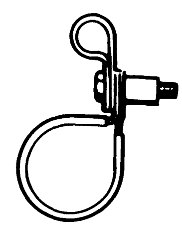
DETAIL **B**



DETAIL **C**



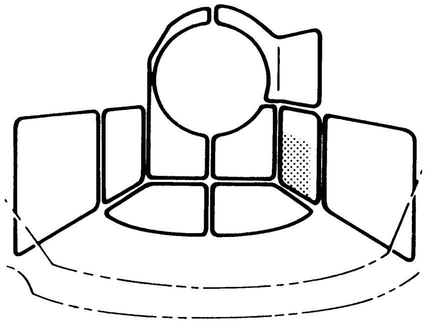
DETAIL **D**



DETAIL **G**

4C-2-8-(184-2)

Figure 14-11. Left Enigne Bay Zone F - AFTER T.O.1F-4C-598 (Sheet 2 of 6)



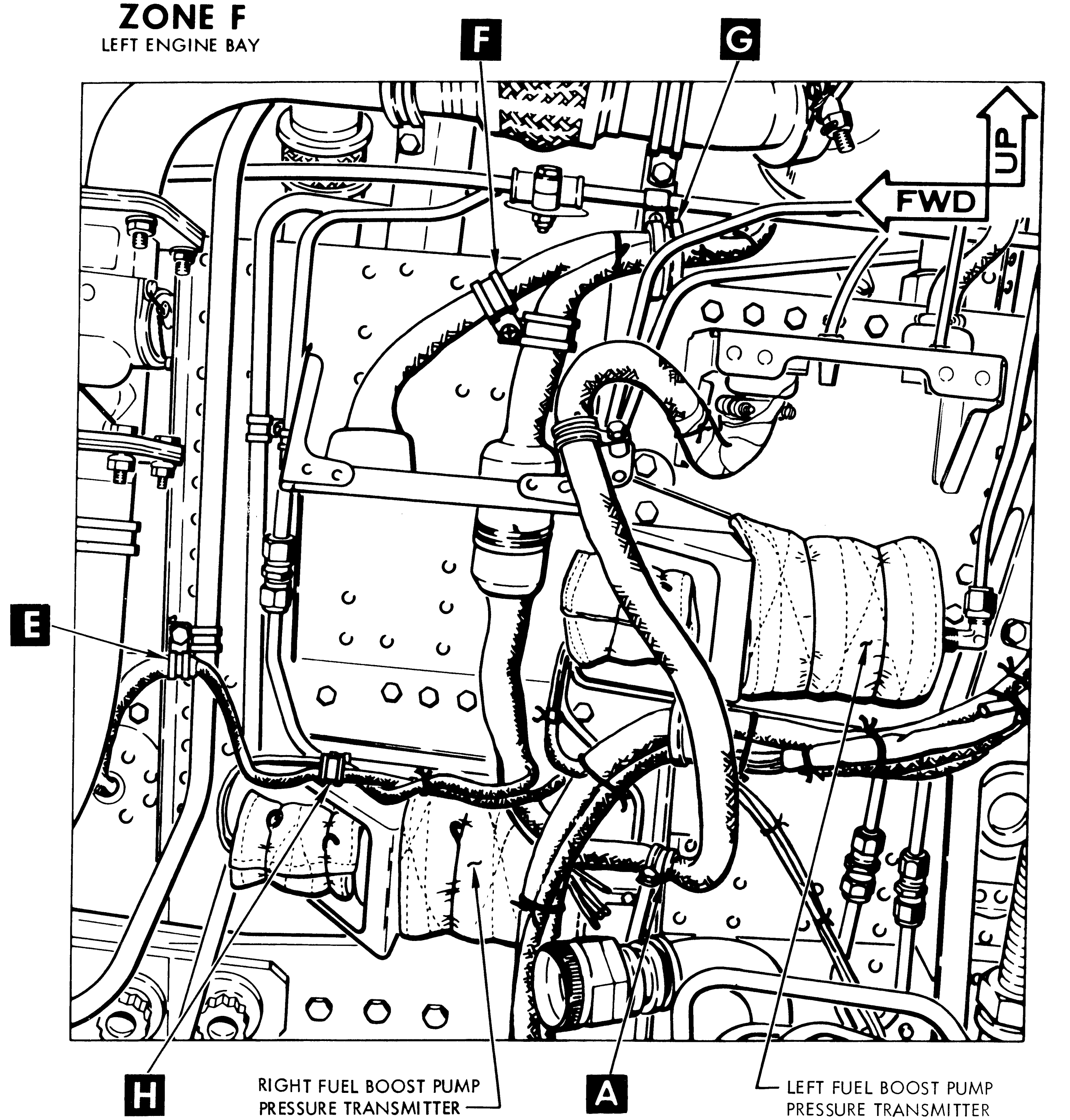
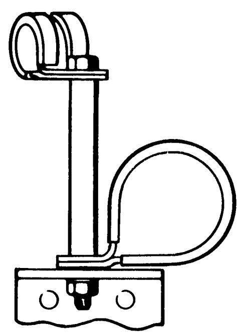
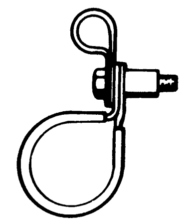


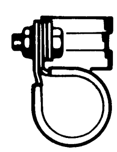
Figure 14-11. Left Engine Bay Zone F – AFTER T.O.1F-4C-598 (Sheet 3 of 6)



DETAIL A



DETAIL G



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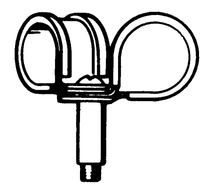
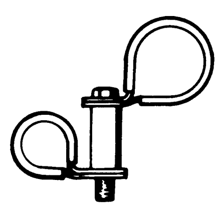


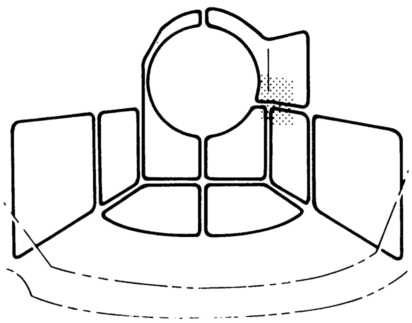
DETAIL F



DETAIL H

4C-2-8-(184-4)

Figure 14-11. Left Engine Bay Zone F - AFTER T.O.1F-4C-598 (Sheet 4 of 6)



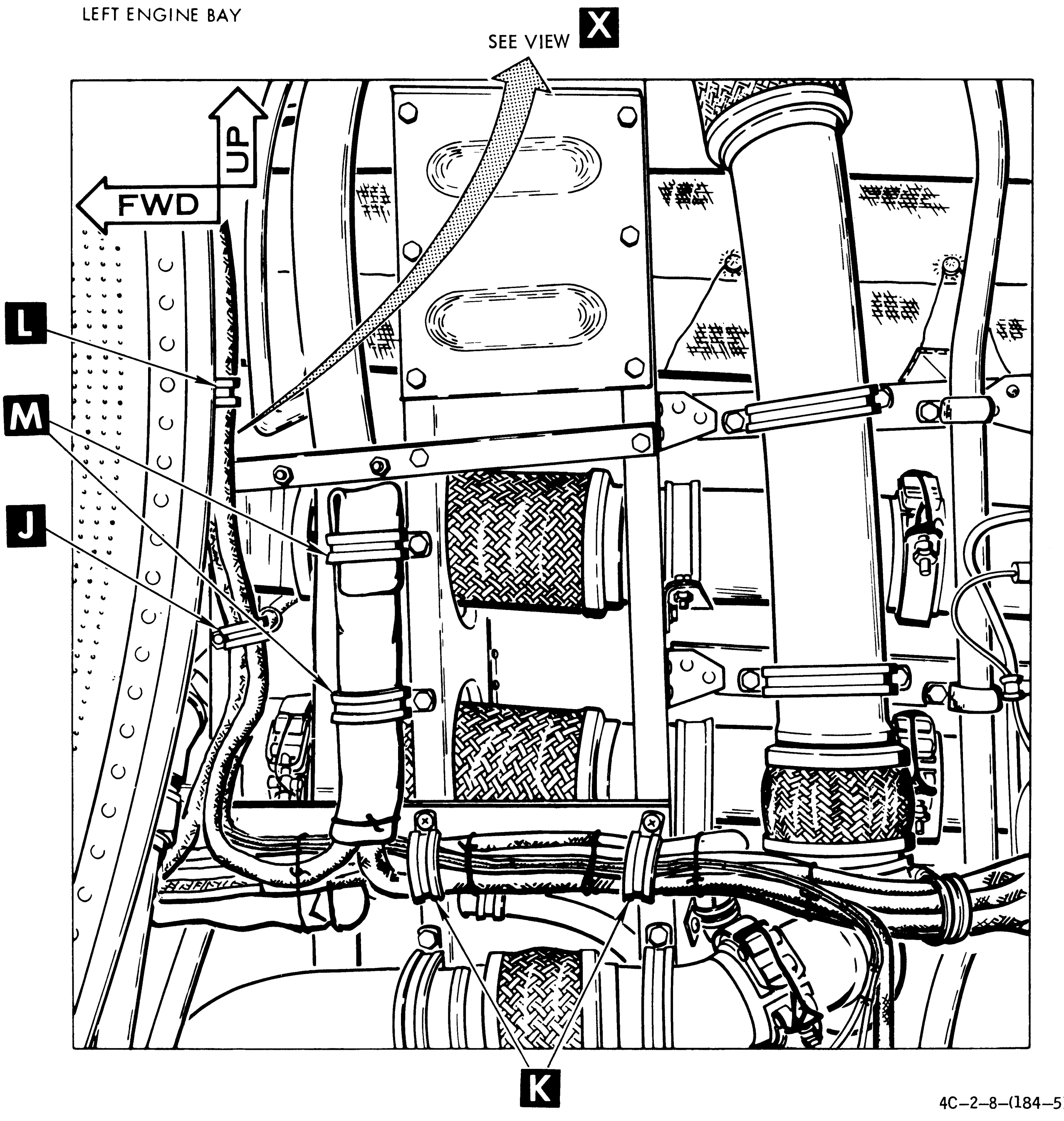


Figure 14-11. Left Engine Bay Zone F - AFTER T.O.1F-4C-598 (Sheet 5 of 6)

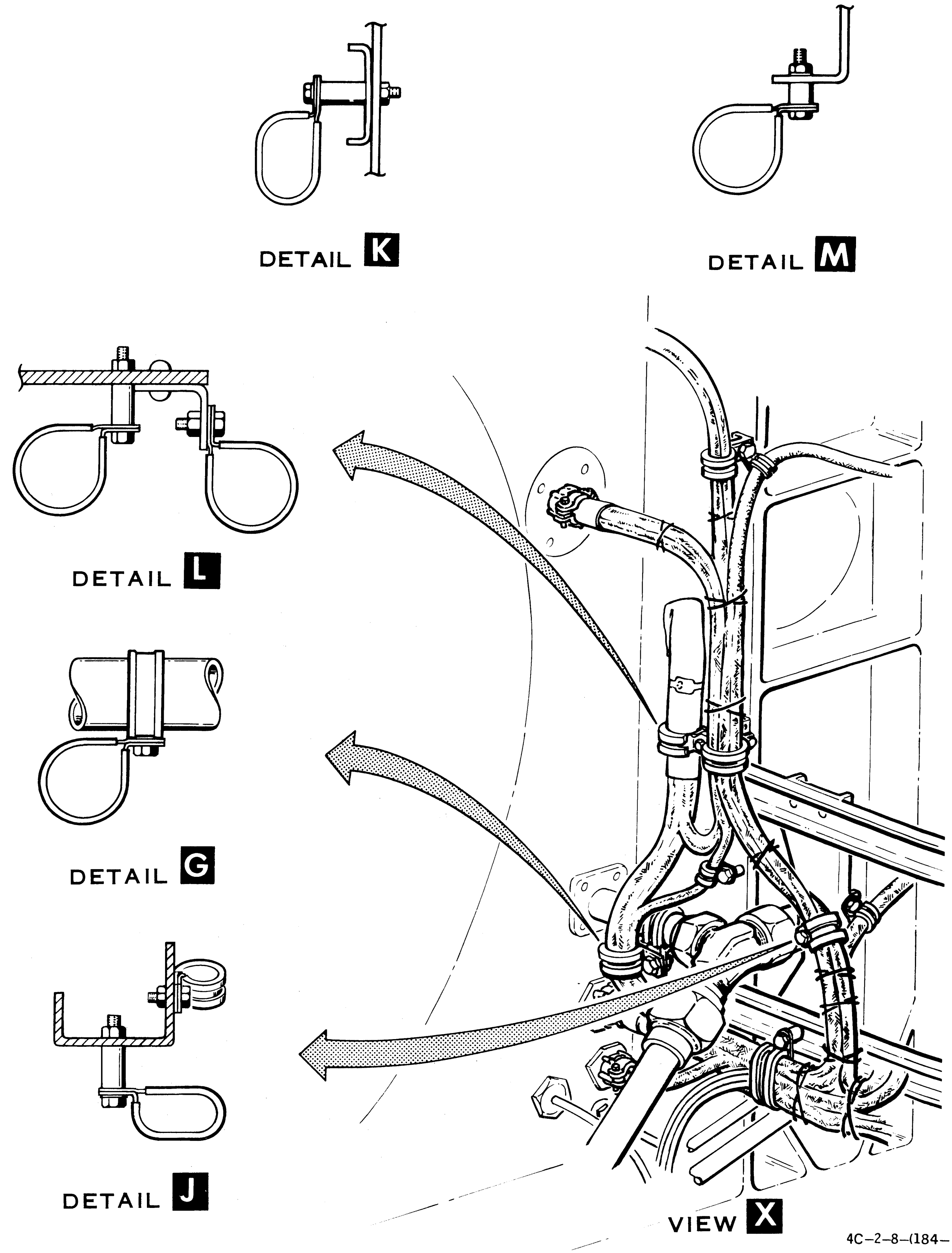
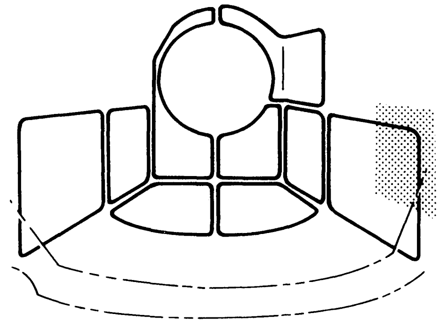


Figure 14-11. Left Engine Bay Zone F - AFTER T.O.1F-4C-598 (Sheet 6 of 6)



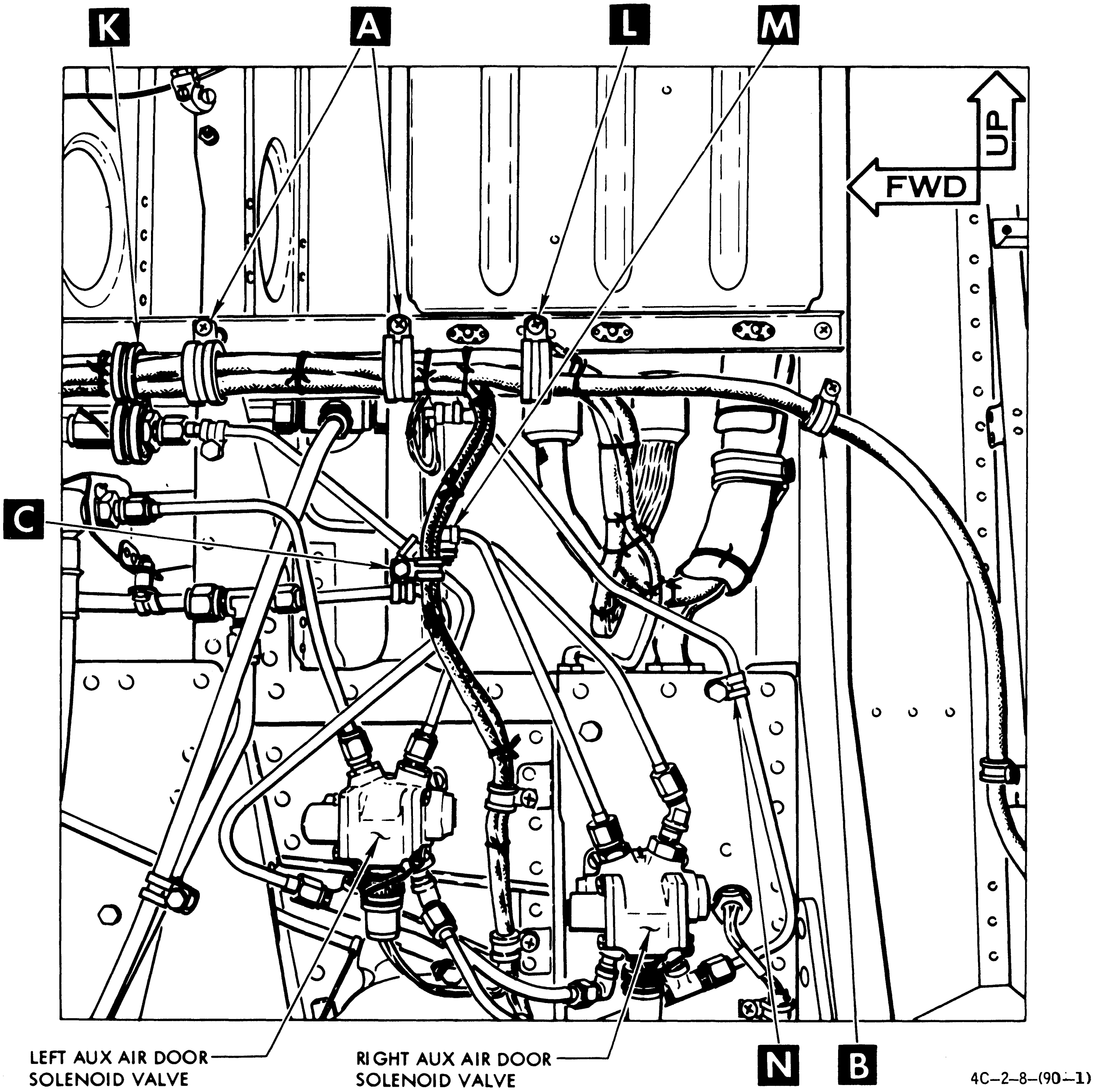
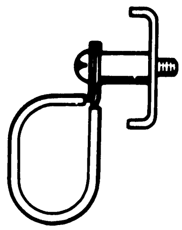
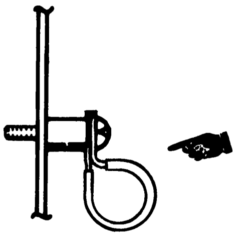


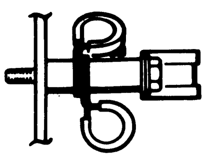
Figure 14-12. Left Engine Bay Zone G (Sheet 1 of 6)



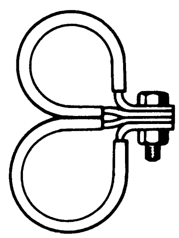
DETAIL A



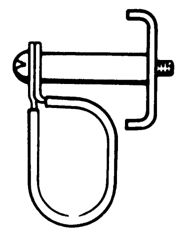
DETAIL B



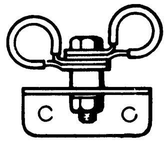
DETAIL C



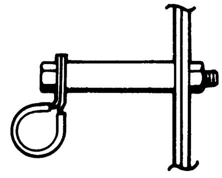
DETAIL K



DETAIL L



DETAIL M



DETAIL N

4C-2-8-(90-2)D

Figure 14-12. Left Engine Bay Zone G (Sheet 2 of 6)

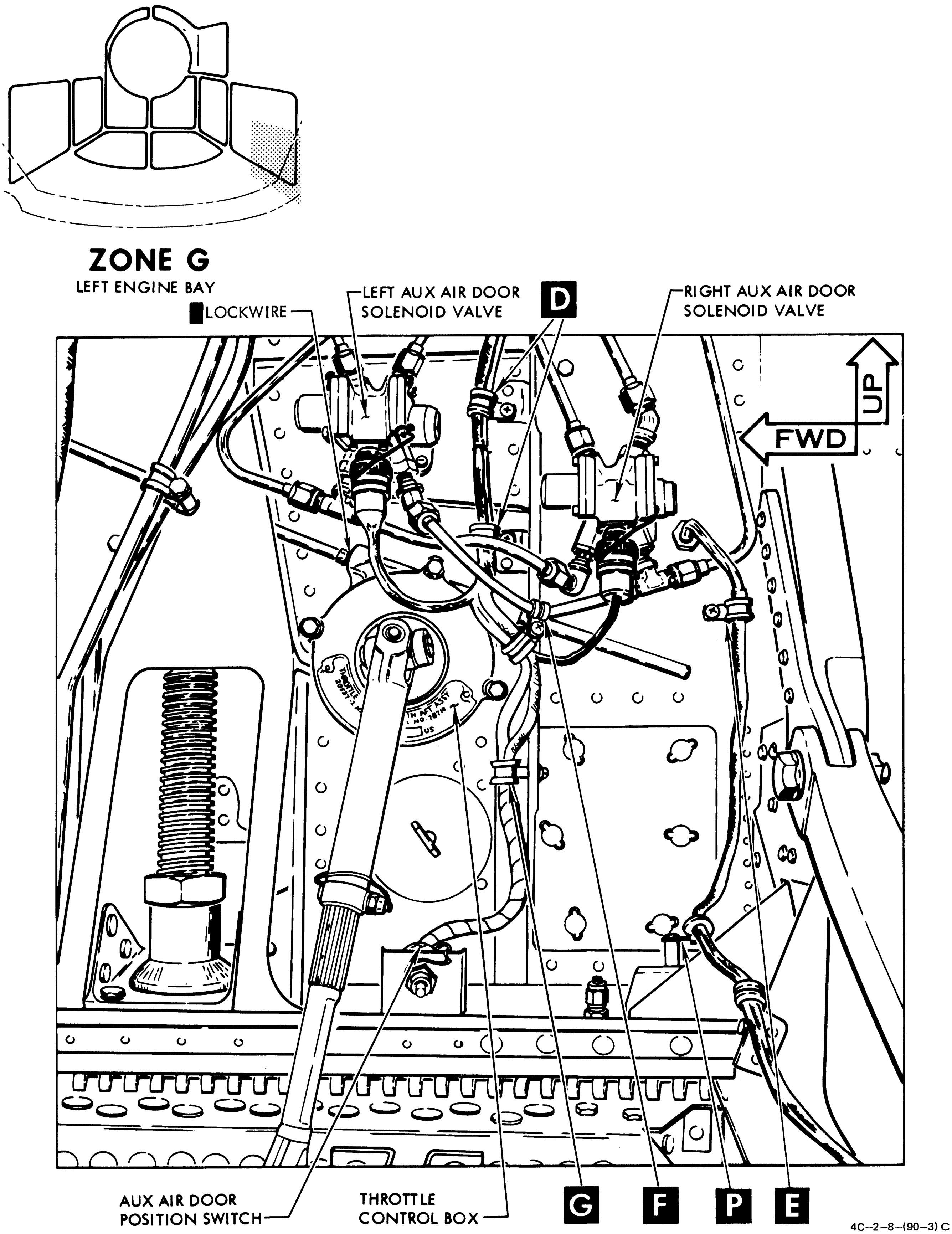
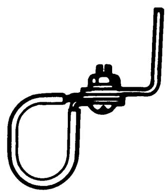
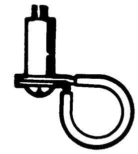


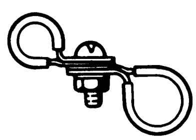
Figure 14-12. Left Engine Bay Zone G (Sheet 3 of 6)



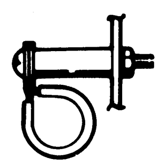
DETAIL D



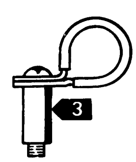
DETAIL E



DETAIL F



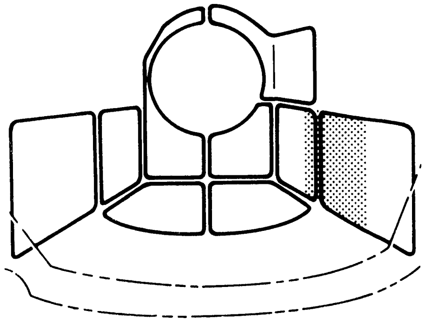
DETAIL G



DETAIL P

4C-2-8-(90-4)

Figure 14-12. Left Engine Bay Zone G (Sheet 4 of 6)



ZONE G
LEFT ENGINE BAY

CRITICAL INFORMATION			
INDEX	MINIMUM CLEARANCE	ANGLE	DESCRIPTION
1		1	AUXILIARY AIR DOOR ACTUATOR

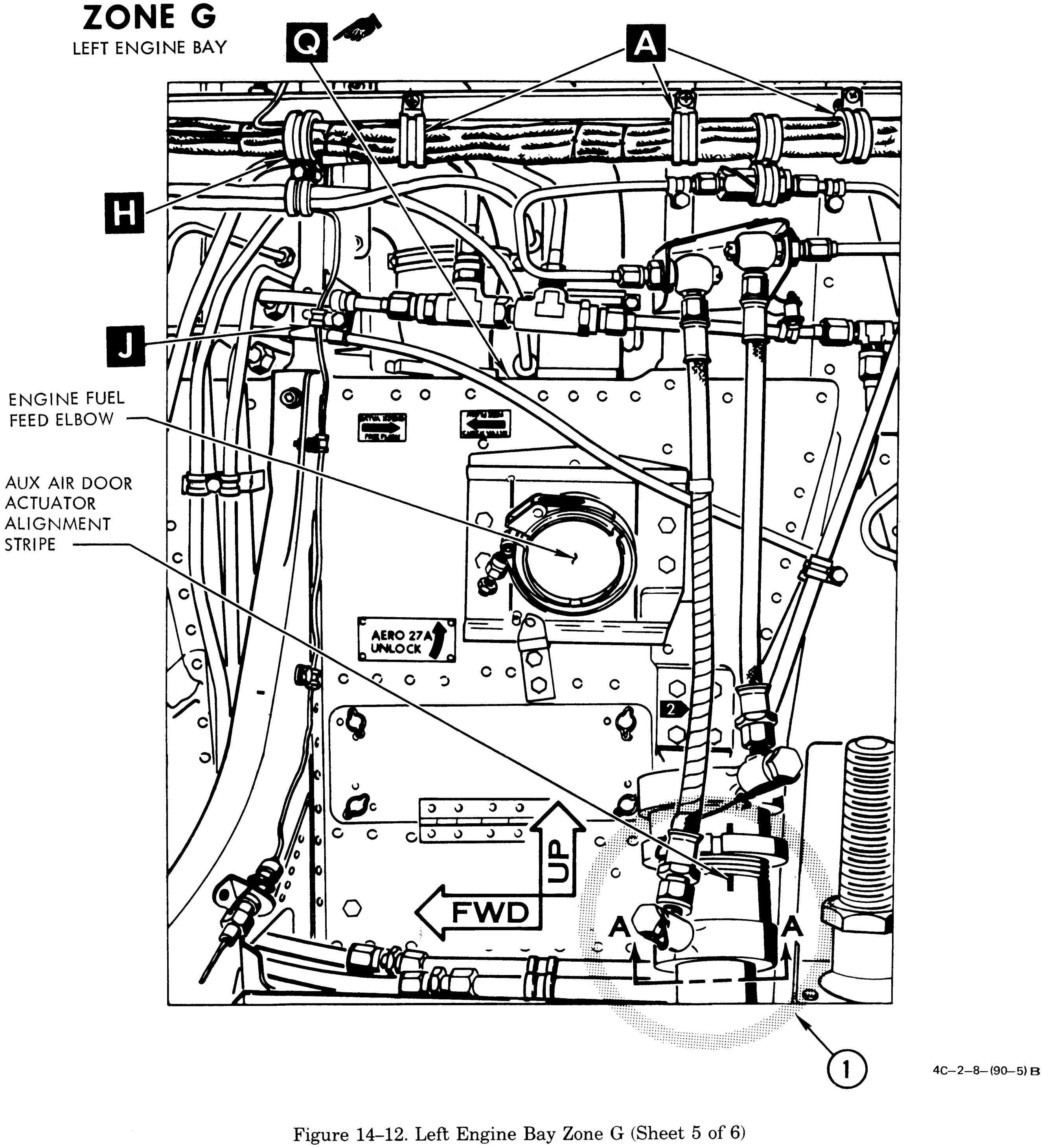


Figure 14-12. Left Engine Bay Zone G (Sheet 5 of 6)

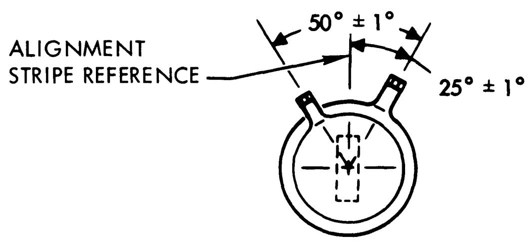
NOTES

1 REFER TO T.O. 1F-4C-2-9 FOR REQUIRED MAINTENANCE INFORMATION. ACTUATOR TO BE IN INSTALLED POSITION DURING ALIGNMENT CHECK.

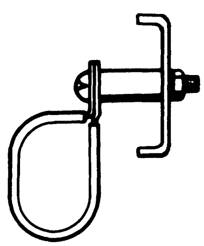
2 WRAP HOSE WITH 10 INCHES OF SPIRAL TEFLON SLEEVE AND SECURE TOP AND BOTTOM WITH SILICONE TAPE.

3 USE 3/4 INCH SPACER.

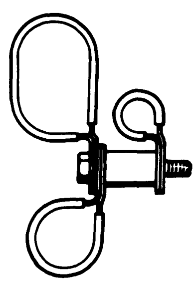
4 CEMENT GROMENTS IN PLACE. SEALING ADHESIVE RTV-106 MAY BE USED TO BOND SEALS IN PLACE.



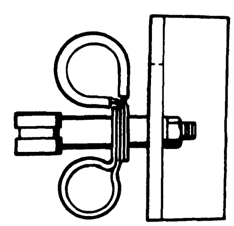
1 VIEW A-A



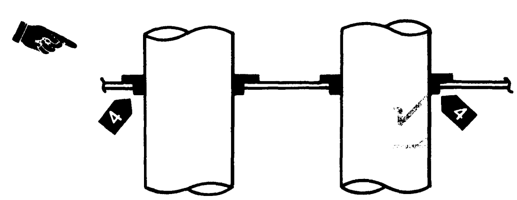
DETAIL A



DETAIL H



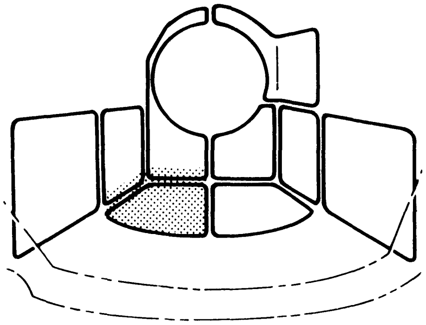
DETAIL J



DETAIL Q

4C-2-8-(90-6) B

Figure 14-12. Left Engine Bay Zone G (Sheet 6 of 6)



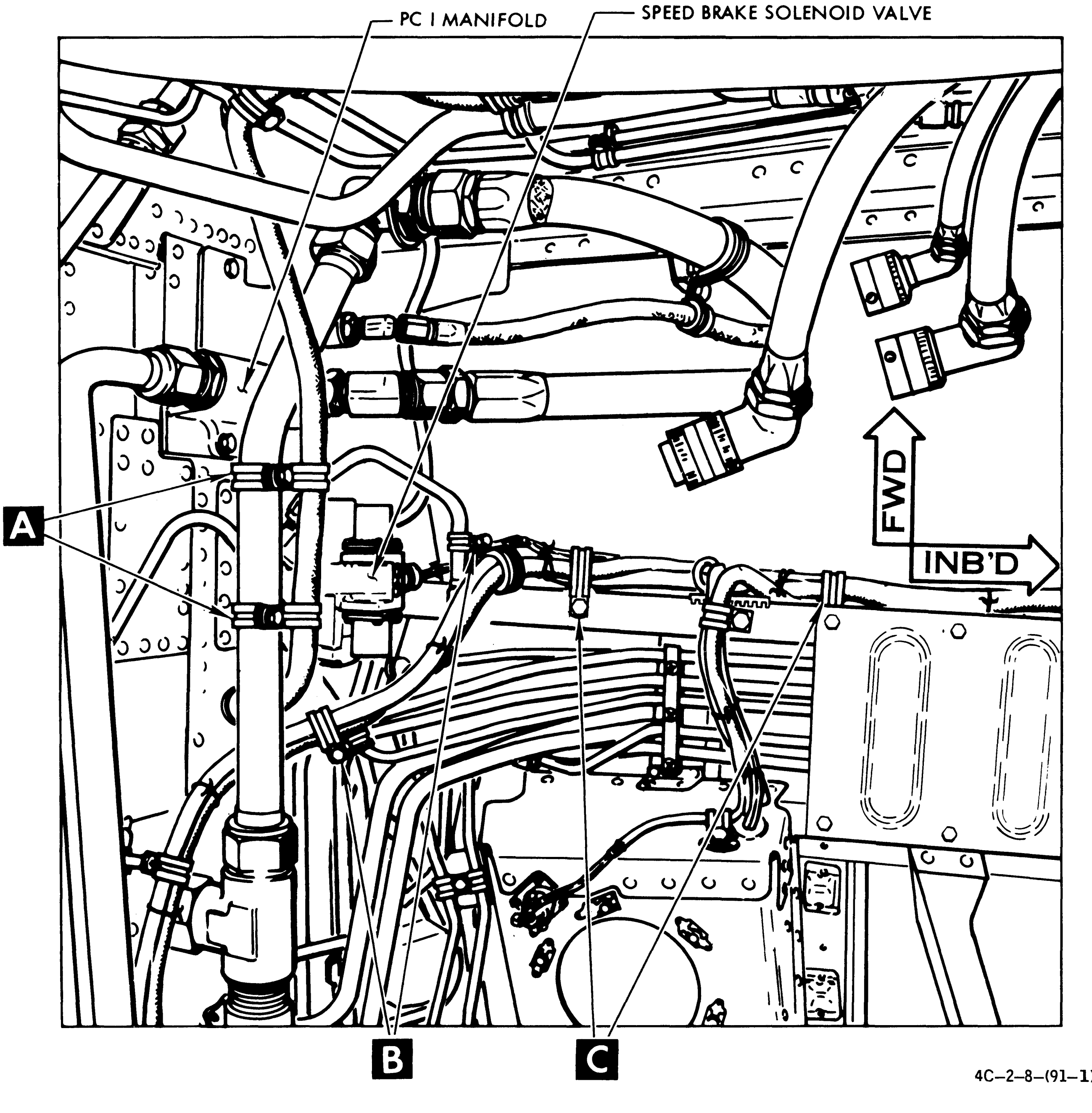
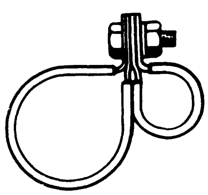
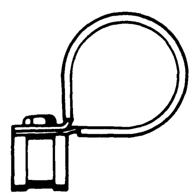


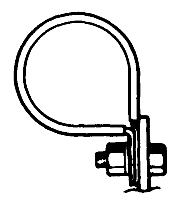
Figure 14-13. Left Engine Bay Zone H (Sheet 1 of 2)



DETAIL A



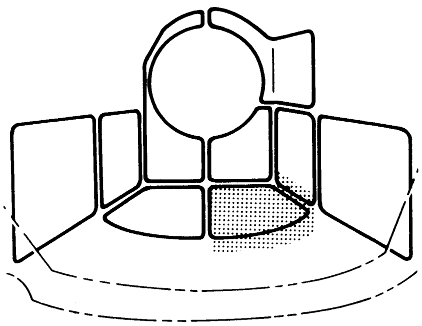
DETAIL B



DETAIL C

4C-2-8-(91-2)

Figure 14-13. Left Engine Bay Zone H (Sheet 2 of 2)



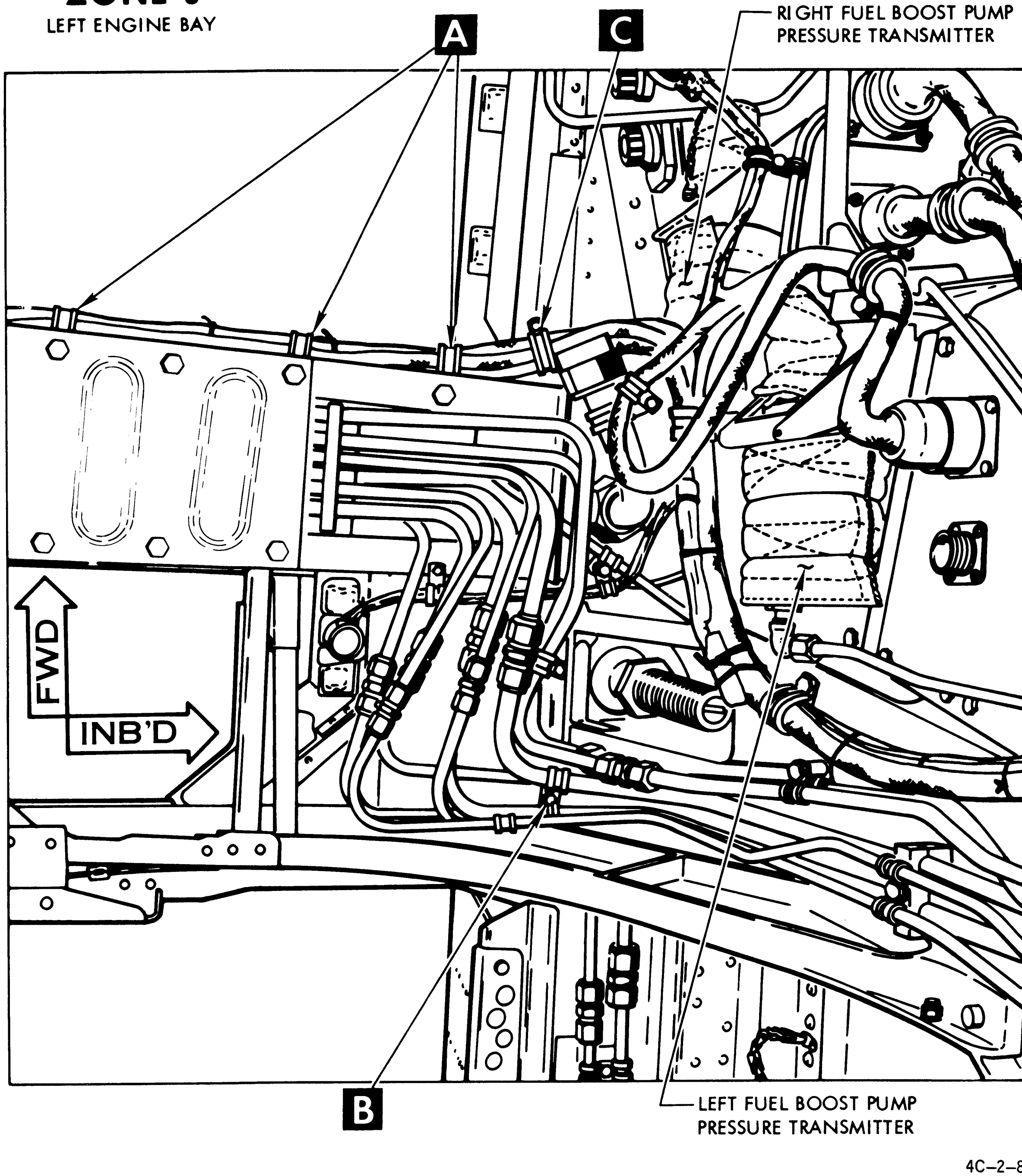
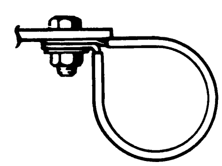
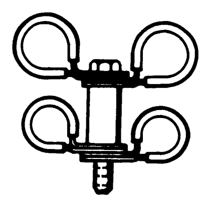


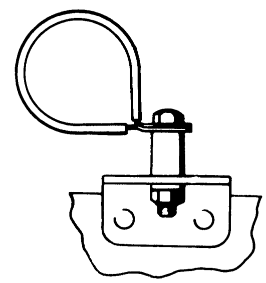
Figure 14-14. Left Engine Bay Zone J - BEFORE T.O.1F-4C-598 (Sheet 1 of 2)



DETAIL **A**



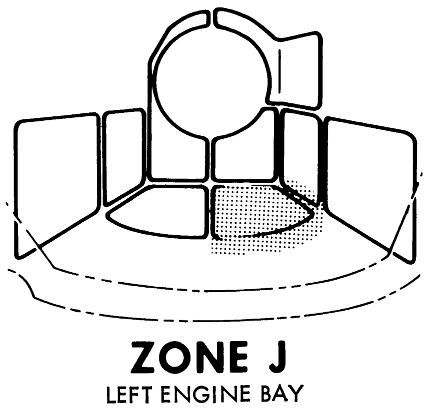
DETAIL **B**



DETAIL **C**

4C-2-8-(92—2)

Figure 14-14. Left Engine Bay Zone J – BEFORE T.O.1F-4C-598 (Sheet 2 of 2)



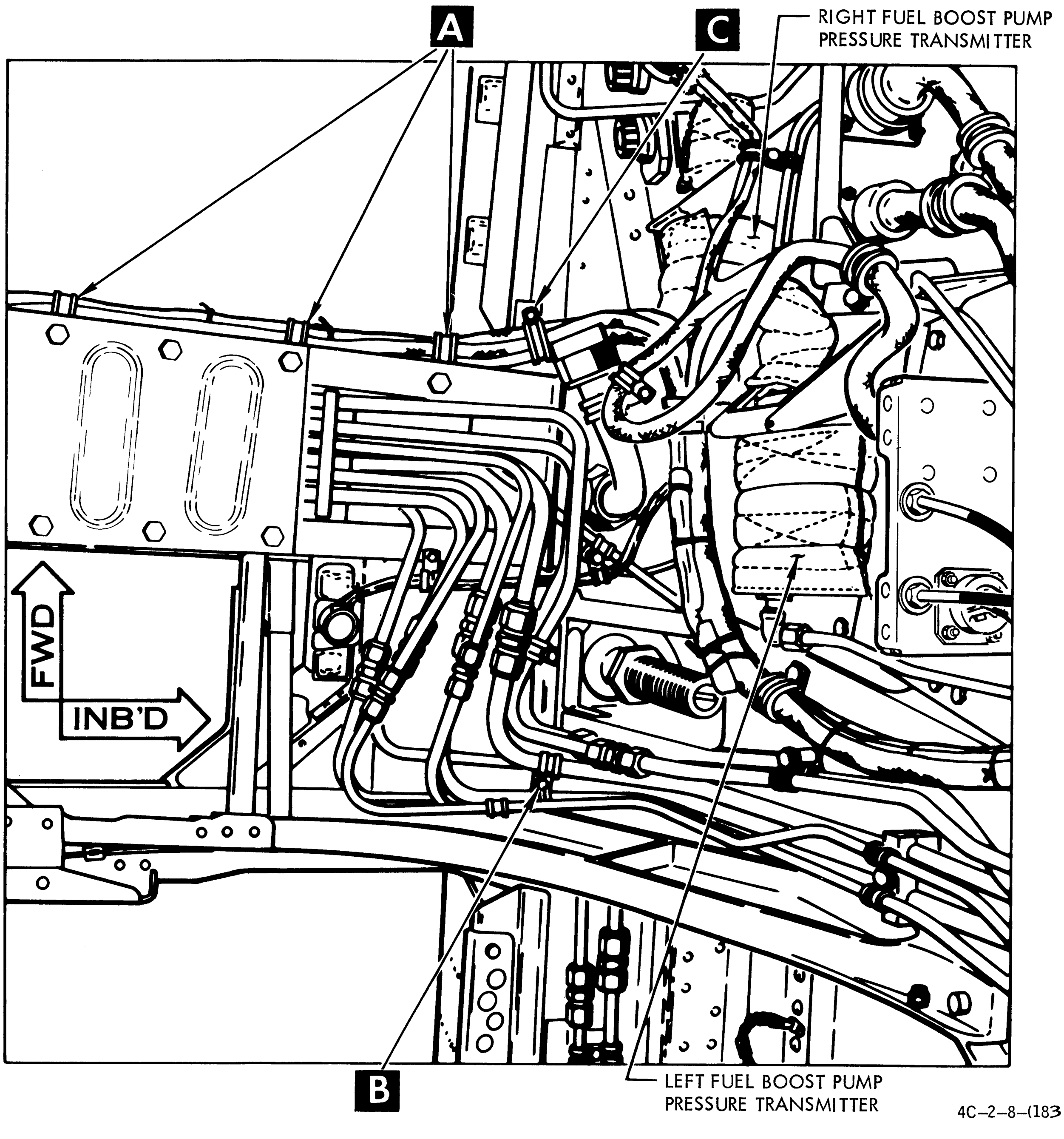
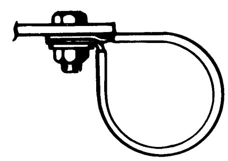
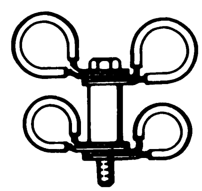


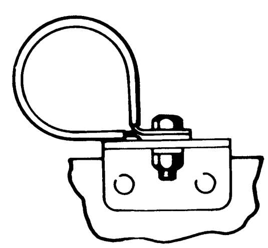
Figure 14-15. Left Engine Bay Zone J – AFTER T.O.1F-4C-598 (Sheet 1 of 2)



DETAIL A



DETAIL B



DETAIL C

4C-2-8-(183-2)

Figure 14-15. Left Engine Bay Zone J - AFTER T.O.1F-4C-598 (Sheet 2 of 2)

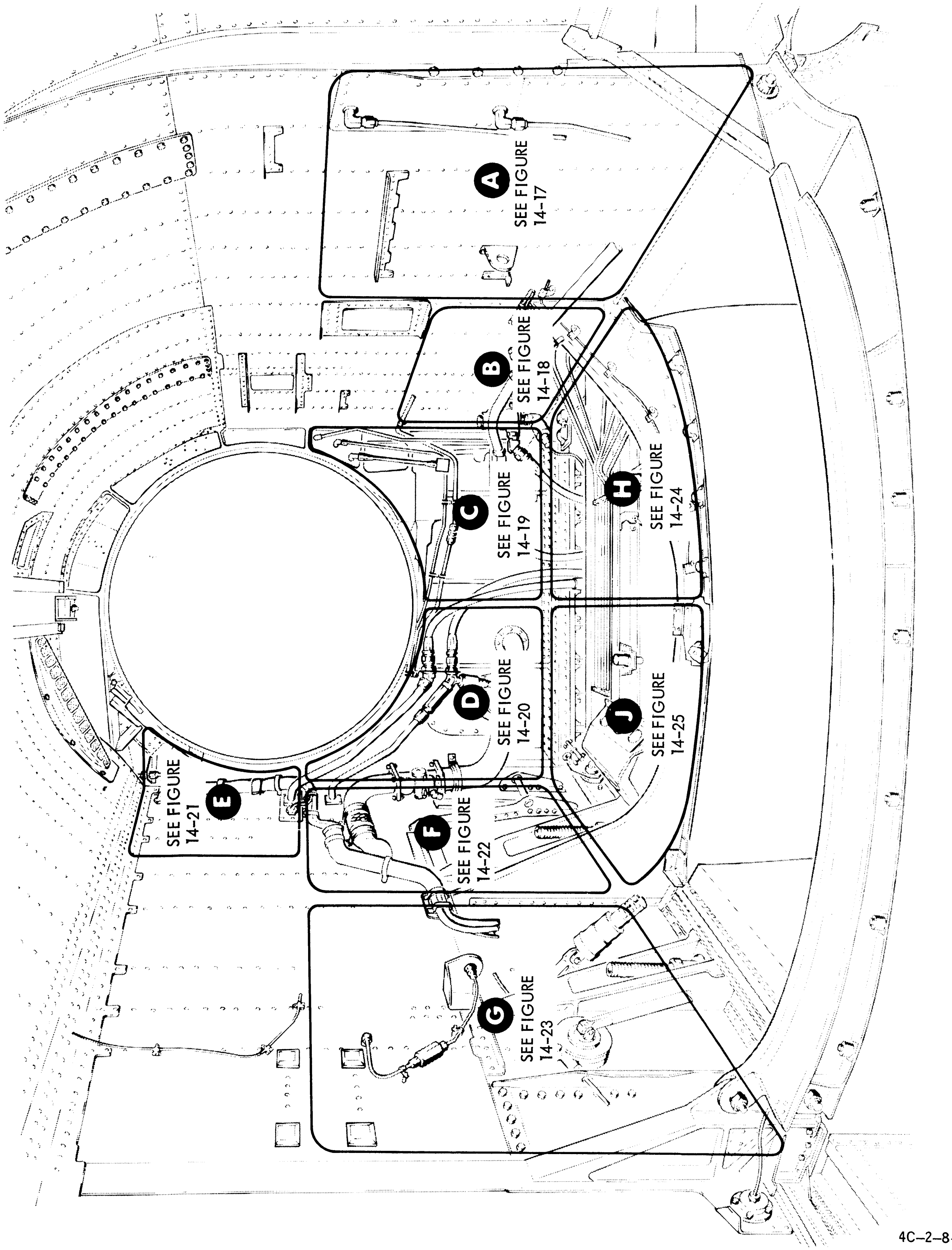
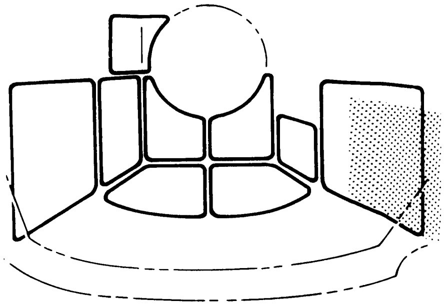


Figure 14-16. Right Engine Bay Orientation



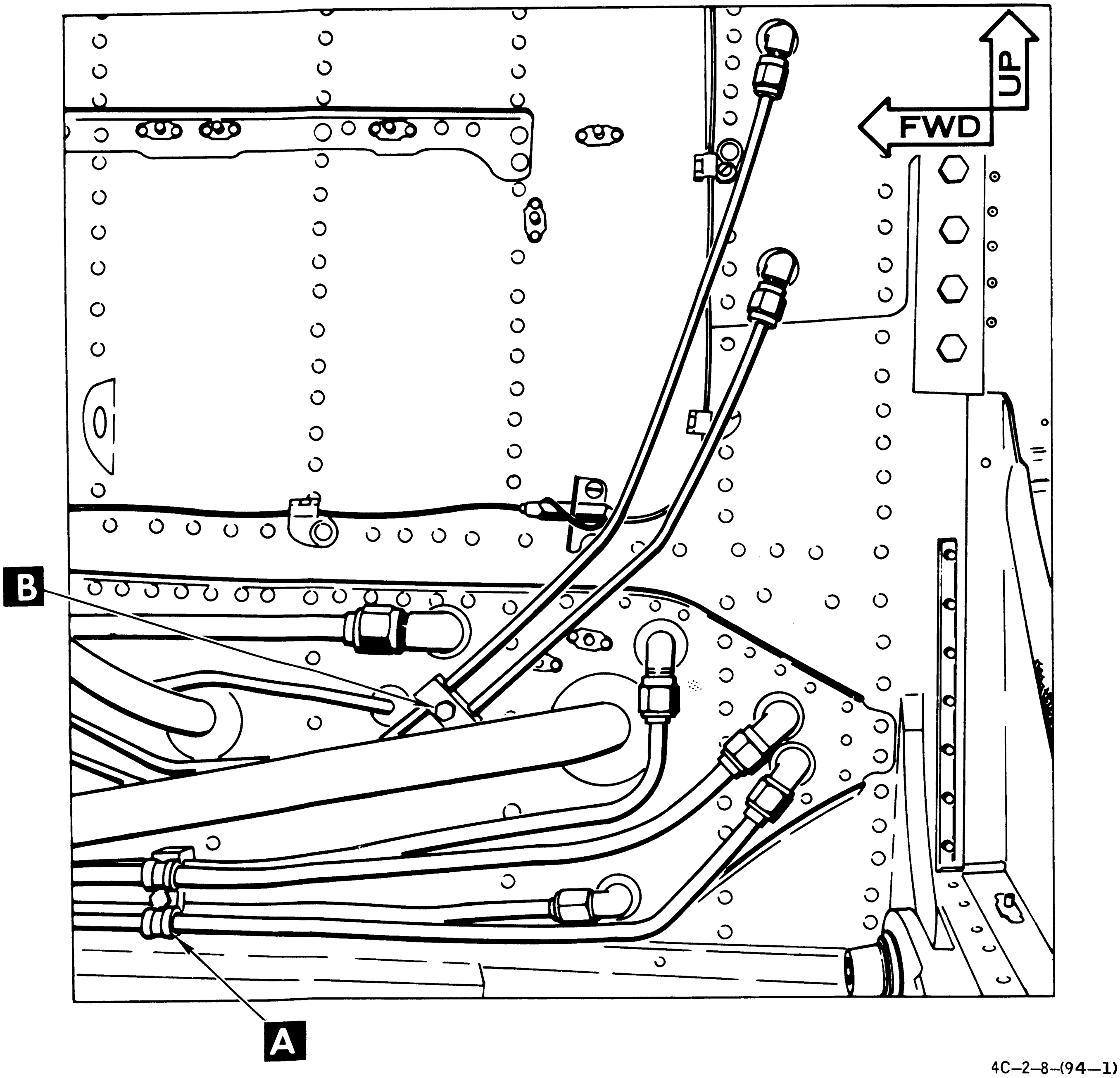
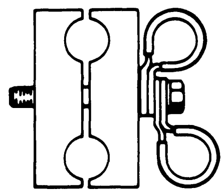
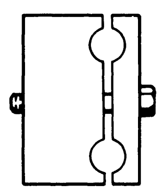


Figure 14-17. Right Engine Bay Zone A (Sheet 1 of 4)



DETAIL A



DETAIL B

4C-2-8-(94-2)

Figure 14-17. Right Engine Bay Zone A (Sheet 2 of 4)

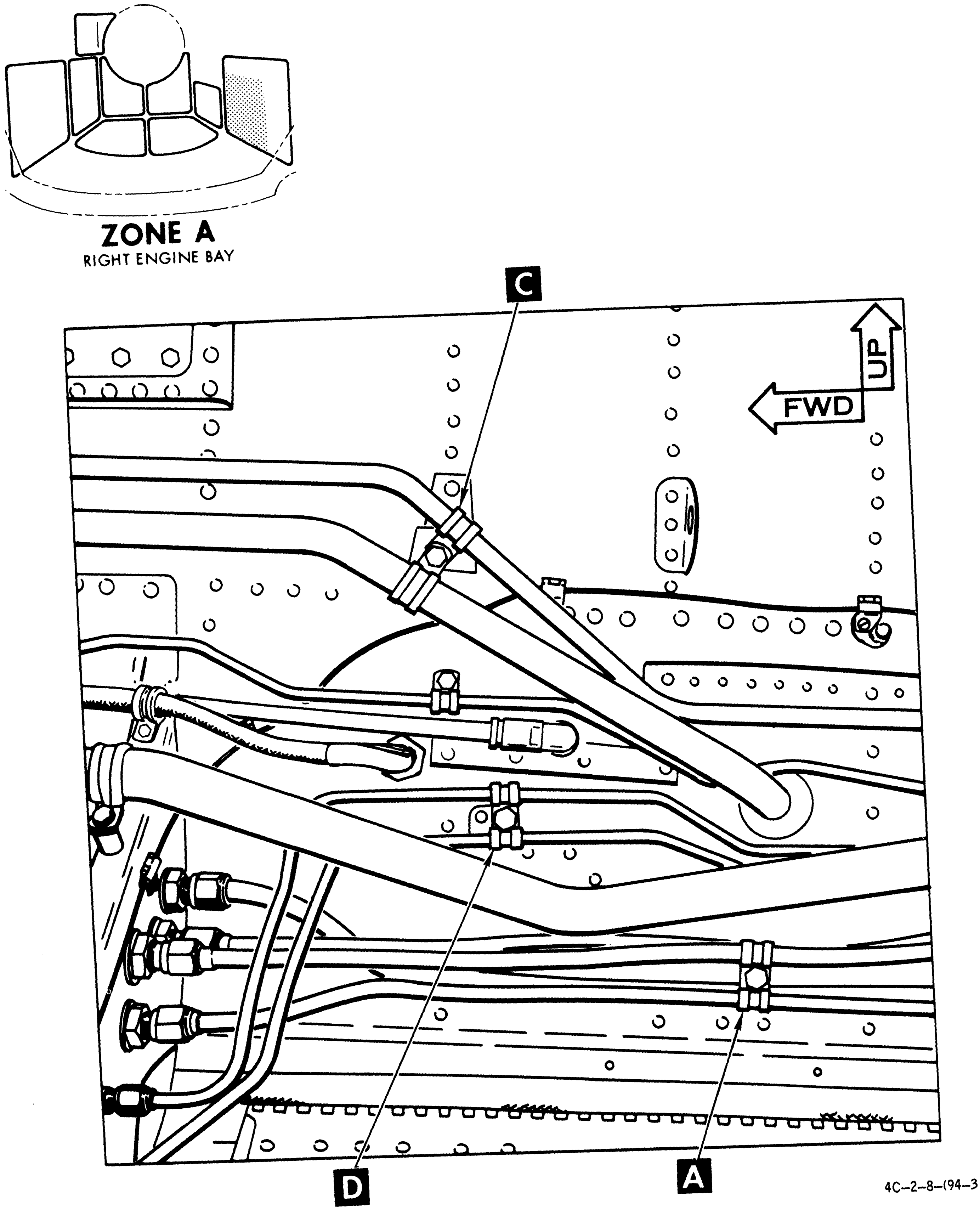
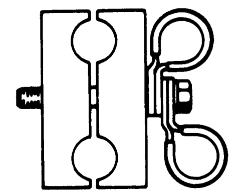
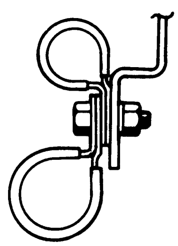


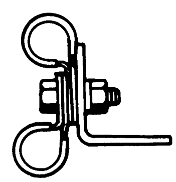
Figure 14-17. Right Engine Bay Zone A (Sheet 3 of 4)



DETAIL A



DETAIL C



DETAIL D

4C-2-8-(94-4)

Figure 14-17. Right Engine Bay Zone A (Sheet 4 of 4)

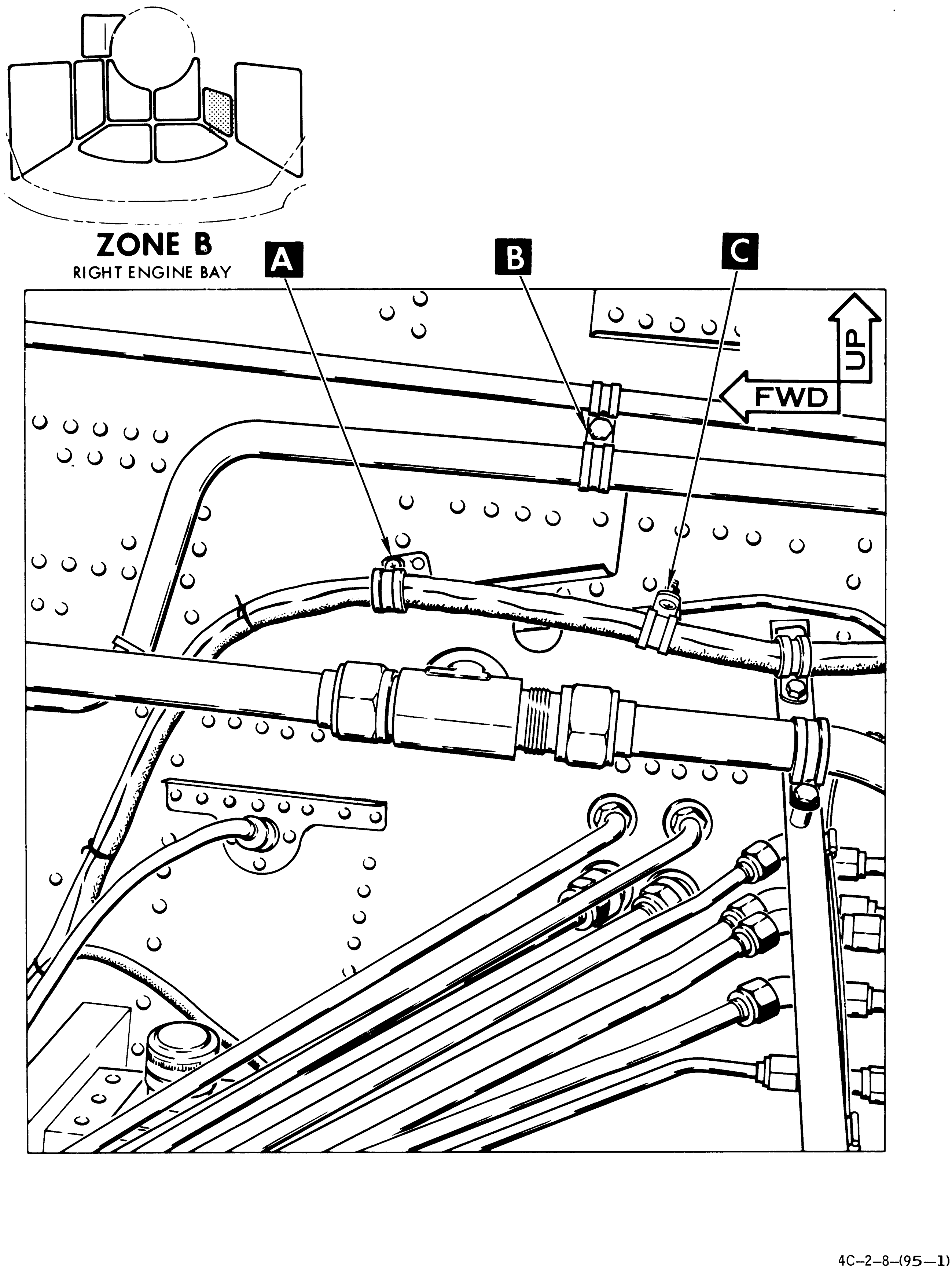
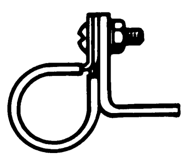
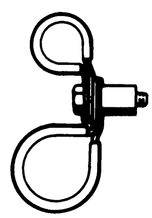


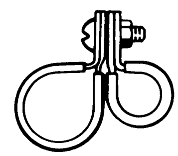
Figure 14-18. Right Engine Bay Zone B (Sheet 1 of 4)



DETAIL A



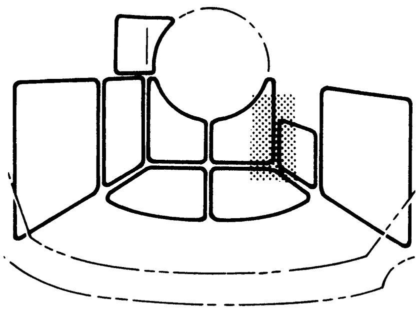
DETAIL B



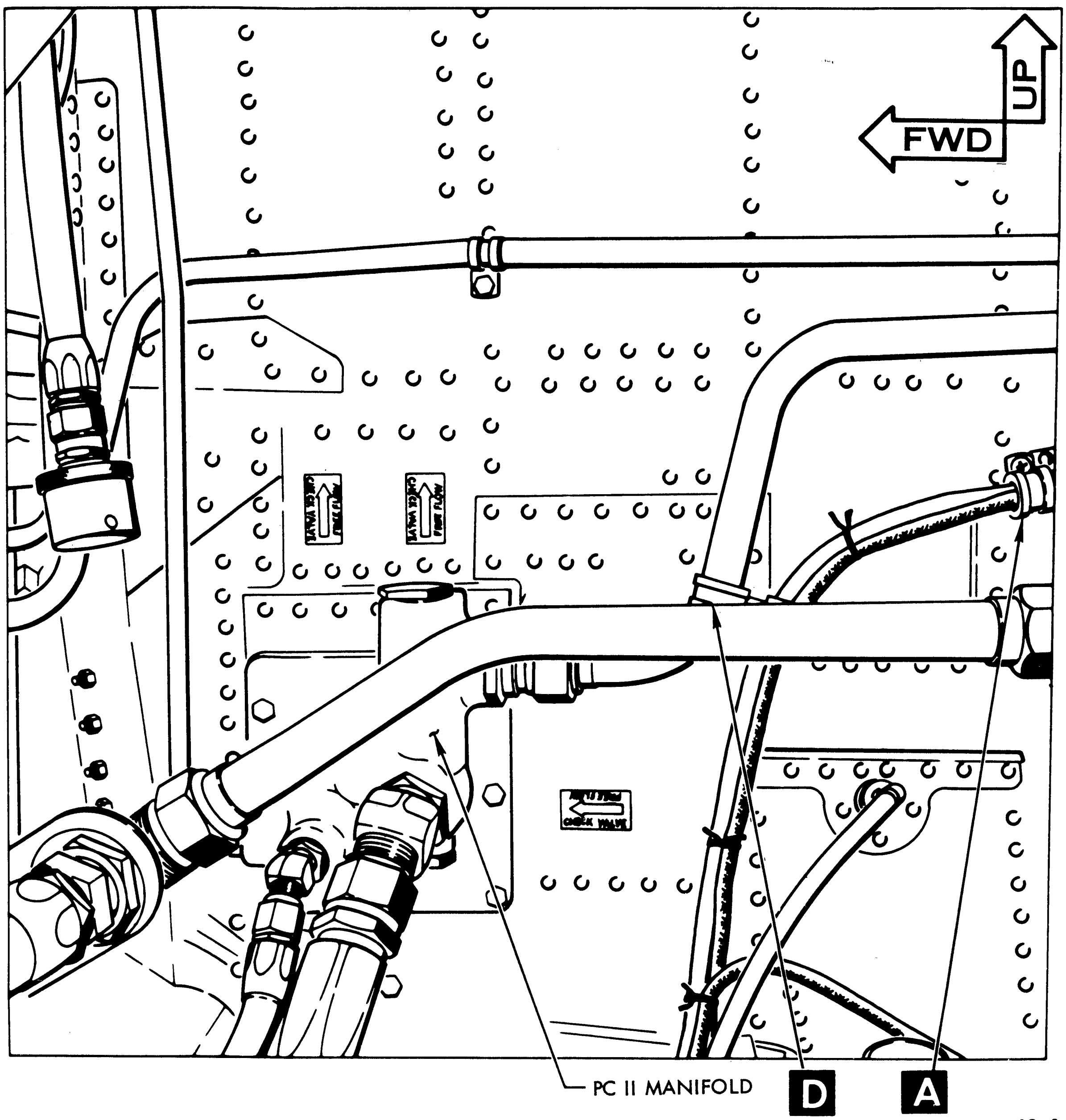
DETAIL C

4C-2-8-(95-2)

Figure 14-18. Right Engine Bay Zone B (Sheet 2 of 4)

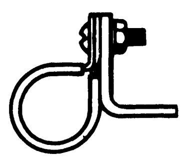


ZONE B
RIGHT ENGINE BAY

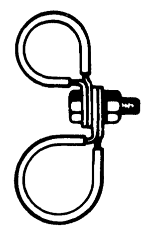


4C-2-8-(95-3)

Figure 14-18. Right Engine Bay Zone B (Sheet 3 of 4)



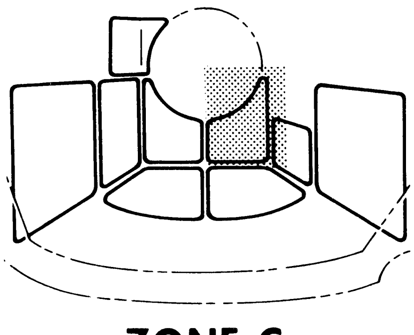
DETAIL A



DETAIL D

4C-2-8-(95-4)

Figure 14-18. Right Engine Bay Zone B (Sheet 4 of 4)



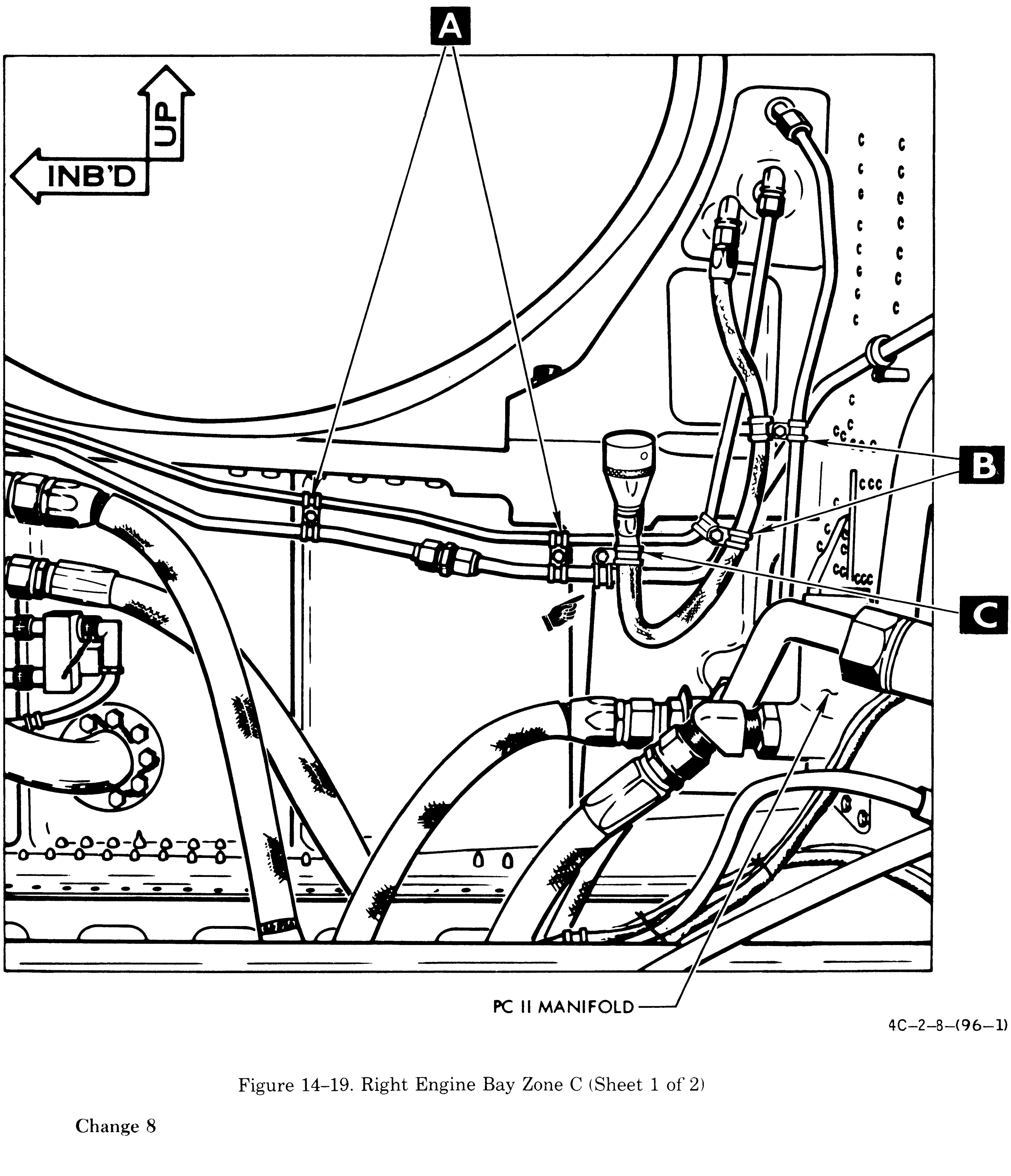
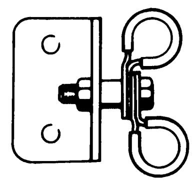
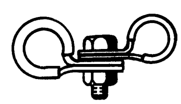


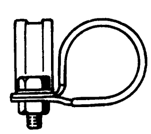
Figure 14-19. Right Engine Bay Zone C (Sheet 1 of 2)



DETAIL A



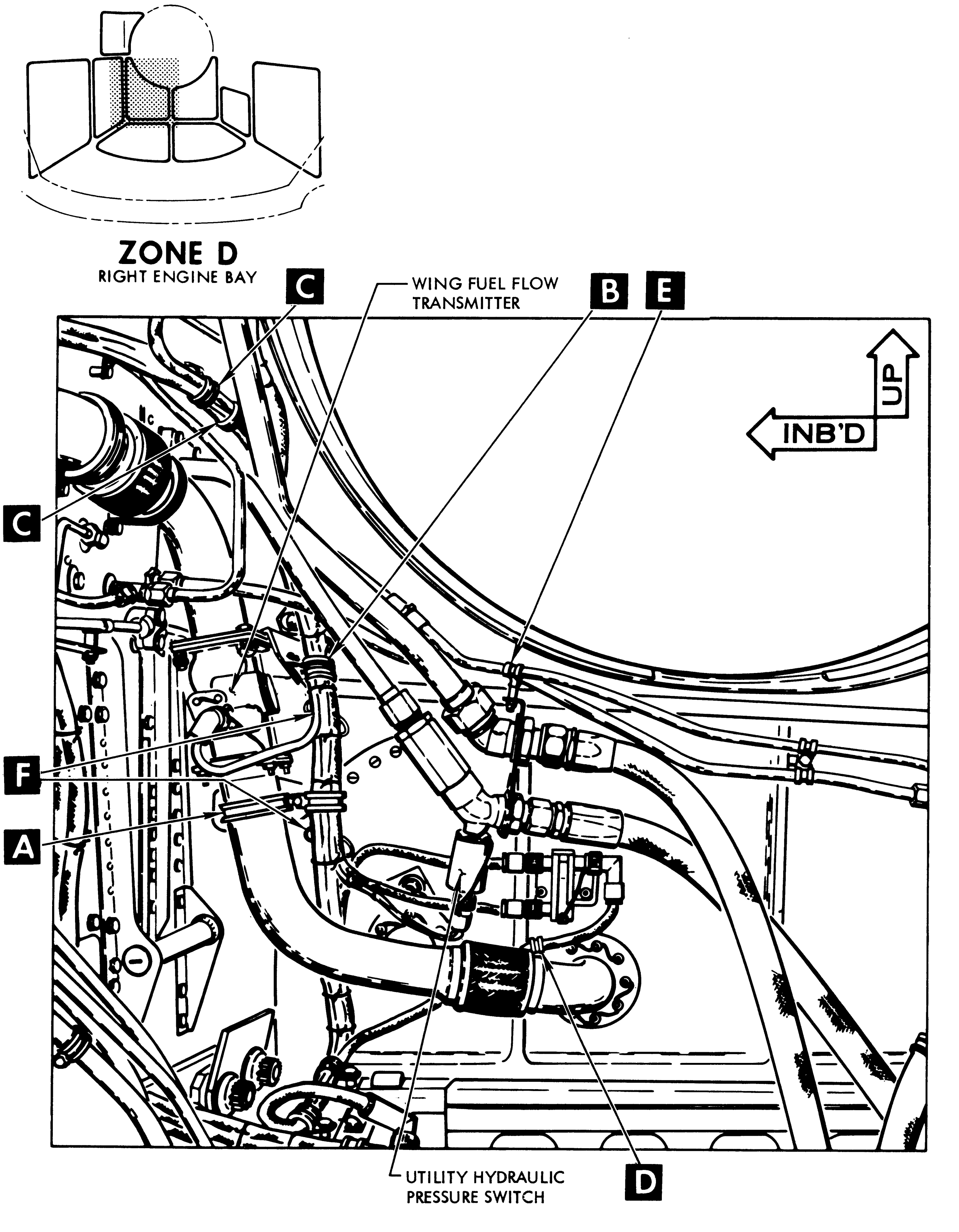
DETAIL B



DETAIL C

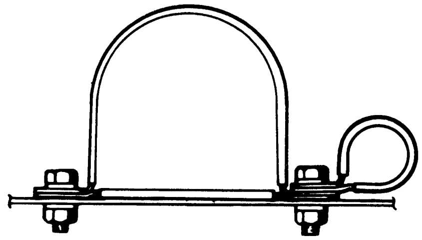
4C-2-8-(96-2)

Figure 14-19. Right Engine Bay Zone C (Sheet 2 of 2)

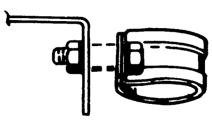


4C-2-8-(97-1)

Figure 14-20. Right Engine Bay Zone D (Sheet 1 of 2)

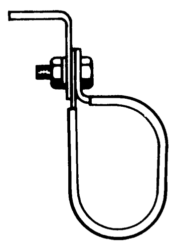


DETAIL A

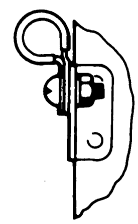


USE SPACER IF REQUIRED
TO MAINTAIN CLEARANCE
WITH BRACKET

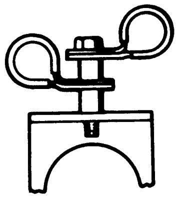
DETAIL B



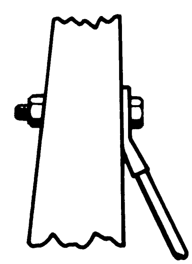
DETAIL C



DETAIL D



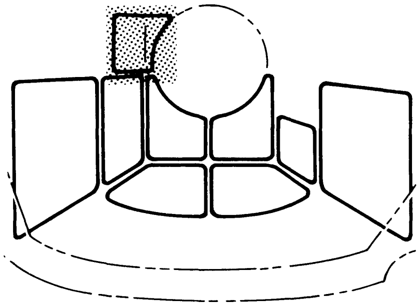
DETAIL E



DETAIL F

4C-2-8-(97—2)

Figure 14-20. Right Engine Bay Zone D (Sheet 2 of 2)



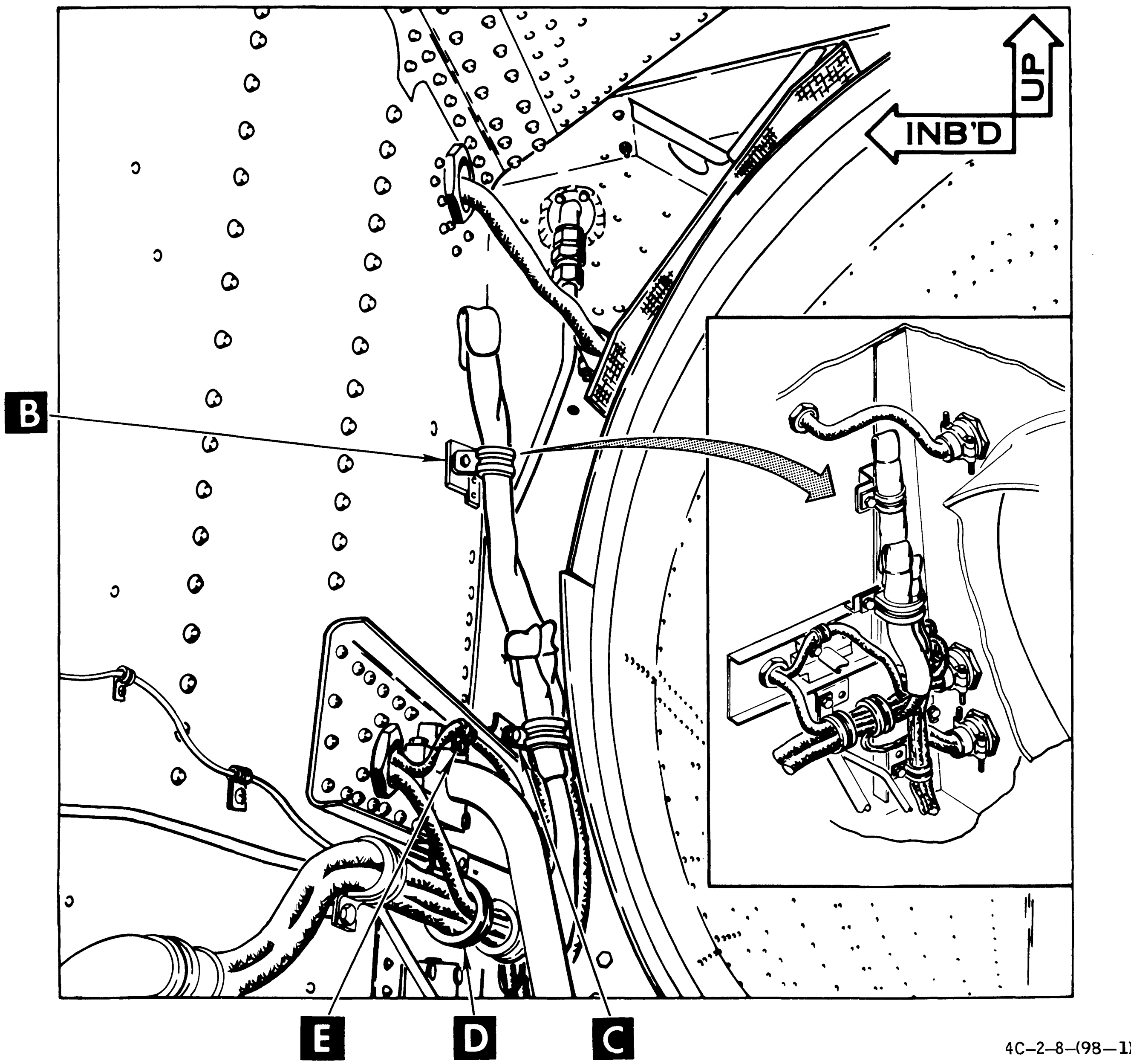
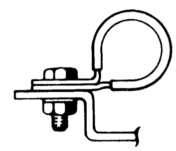
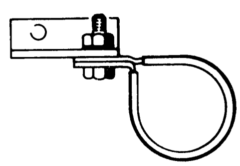


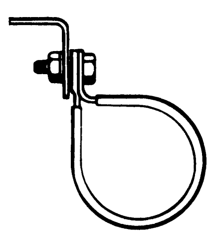
Figure 14-21. Right Engine Bay Zone E (Sheet 1 of 2)



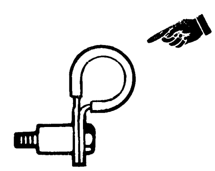
DETAIL B



DETAIL C



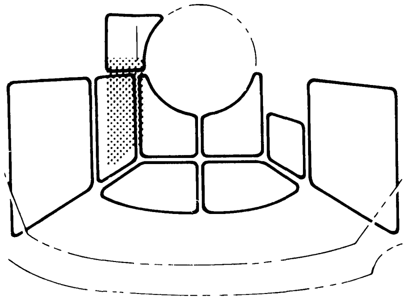
DETAIL D



DETAIL E

4C-2-8-(98-2)A

Figure 14-21. Right Engine Bay Zone E (Sheet 2 of 2)



CRITICAL INFORMATION			
INDEX	MINIMUM CLEARANCE	ANGLE	DESCRIPTION
2	CLEARANCE		THROTTLE CONDUIT TO
	REQD		WING FUEL FLOW
			TRANSMITTER ATTACHING BOLT

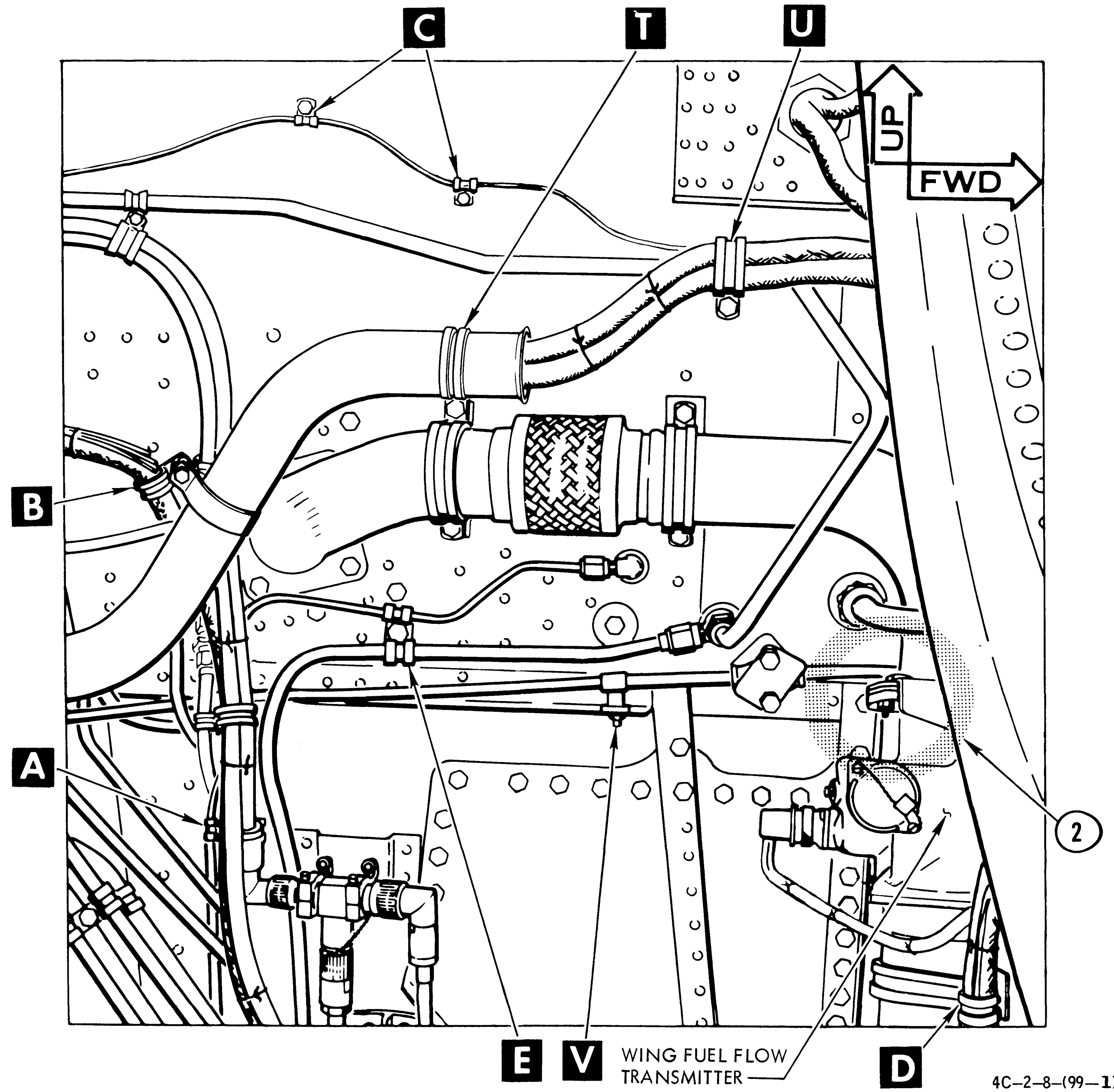


Figure 14-22. Right Engine Bay Zone F (Sheet 1 of 8)

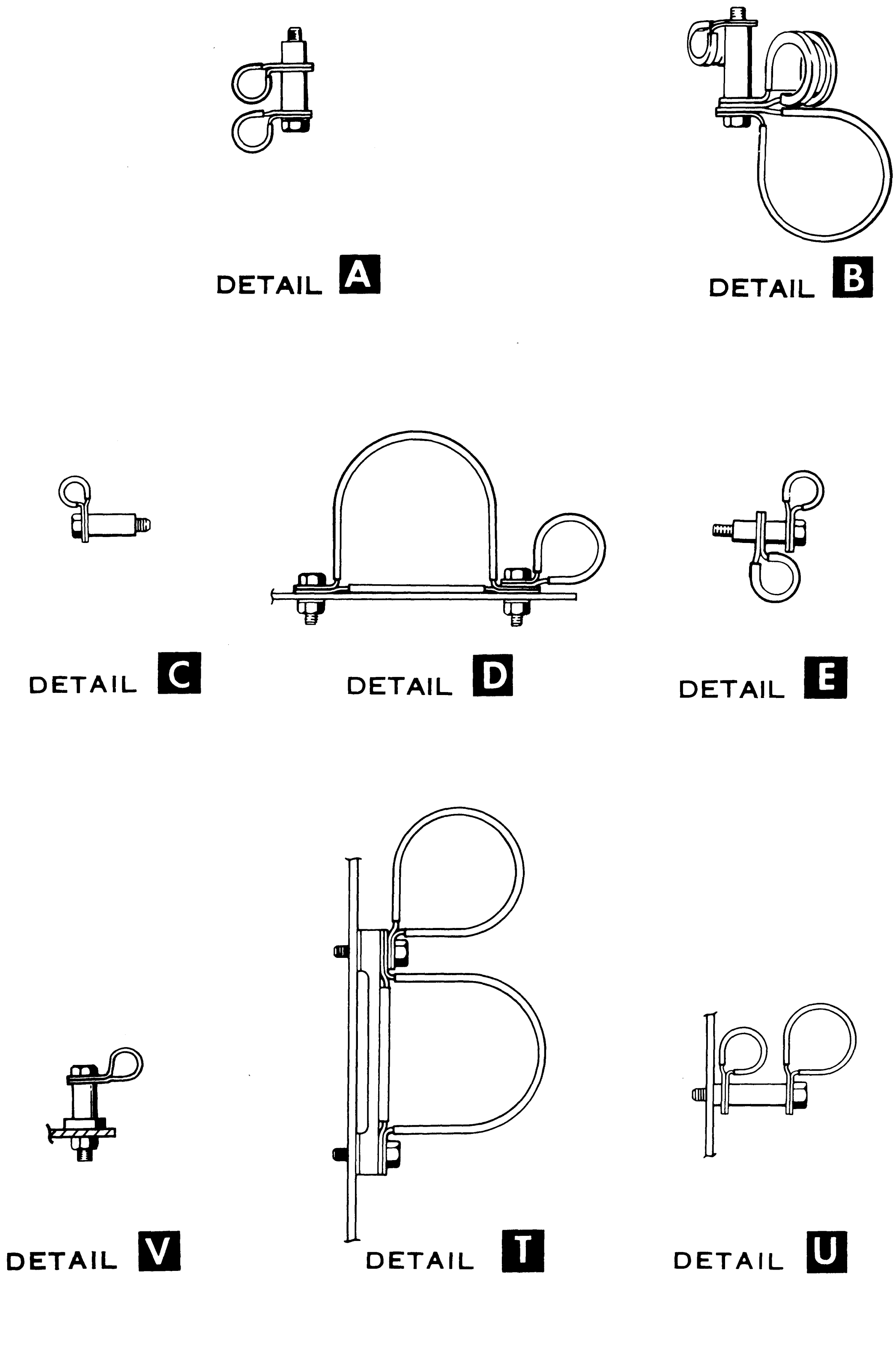
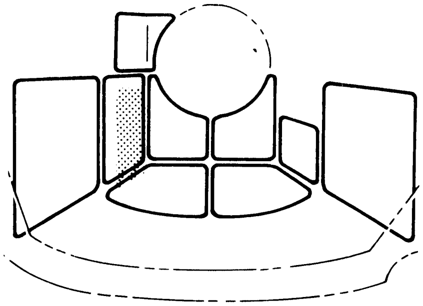


Figure 14-22. Right Engine Bay Zone F (Sheet 2 of 8)



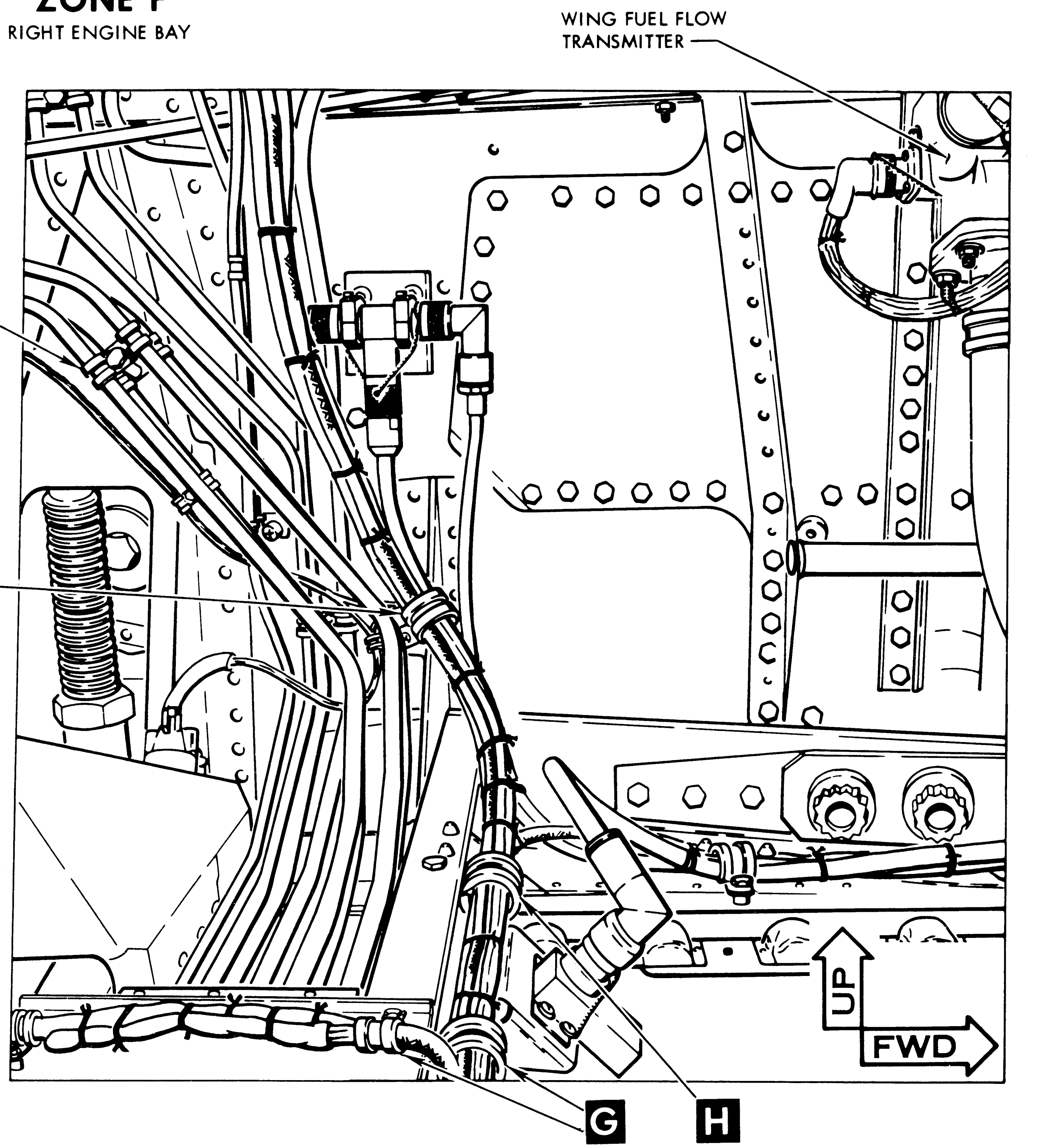
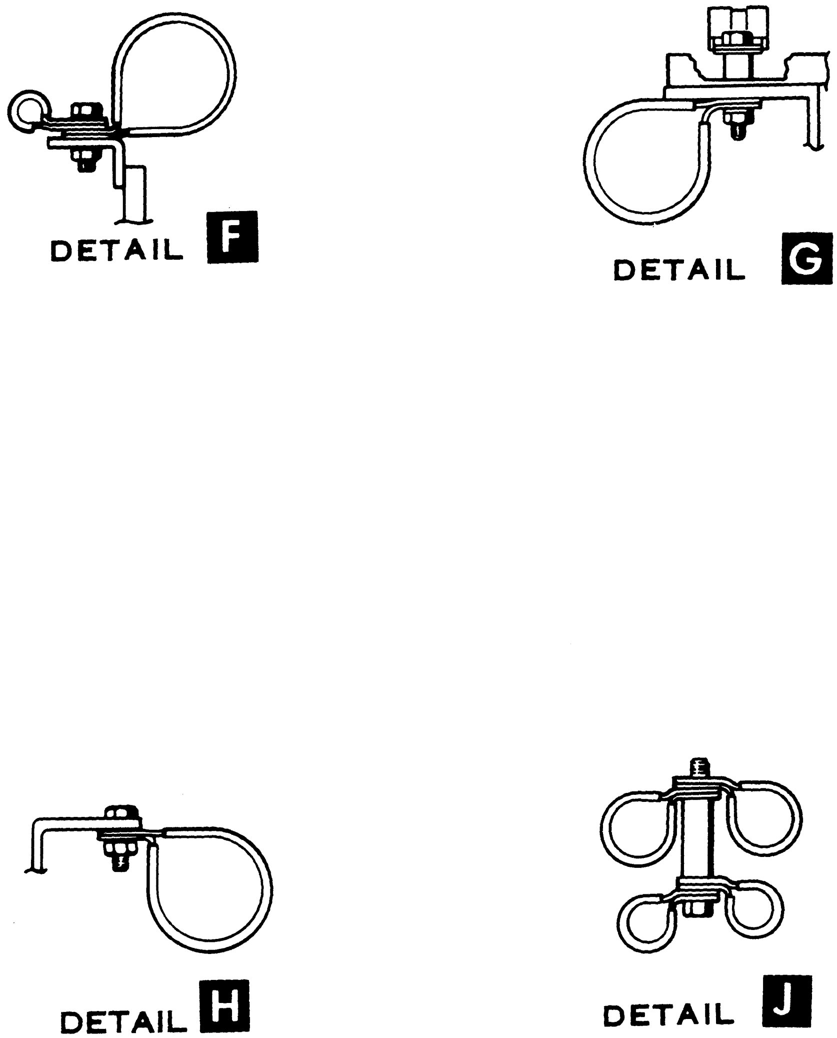
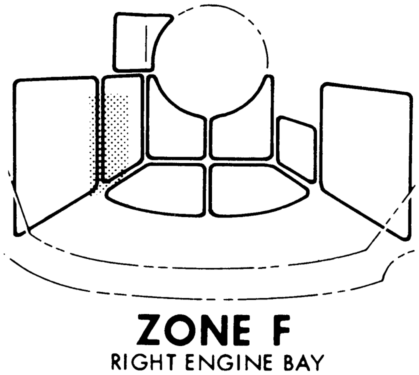


Figure 14-22. Right Engine Bay Zone F (Sheet 3 of 8)



4C-2-8-(99-4)

Figure 14-22. Right Engine Bay Zone F (Sheet 4 of 8)



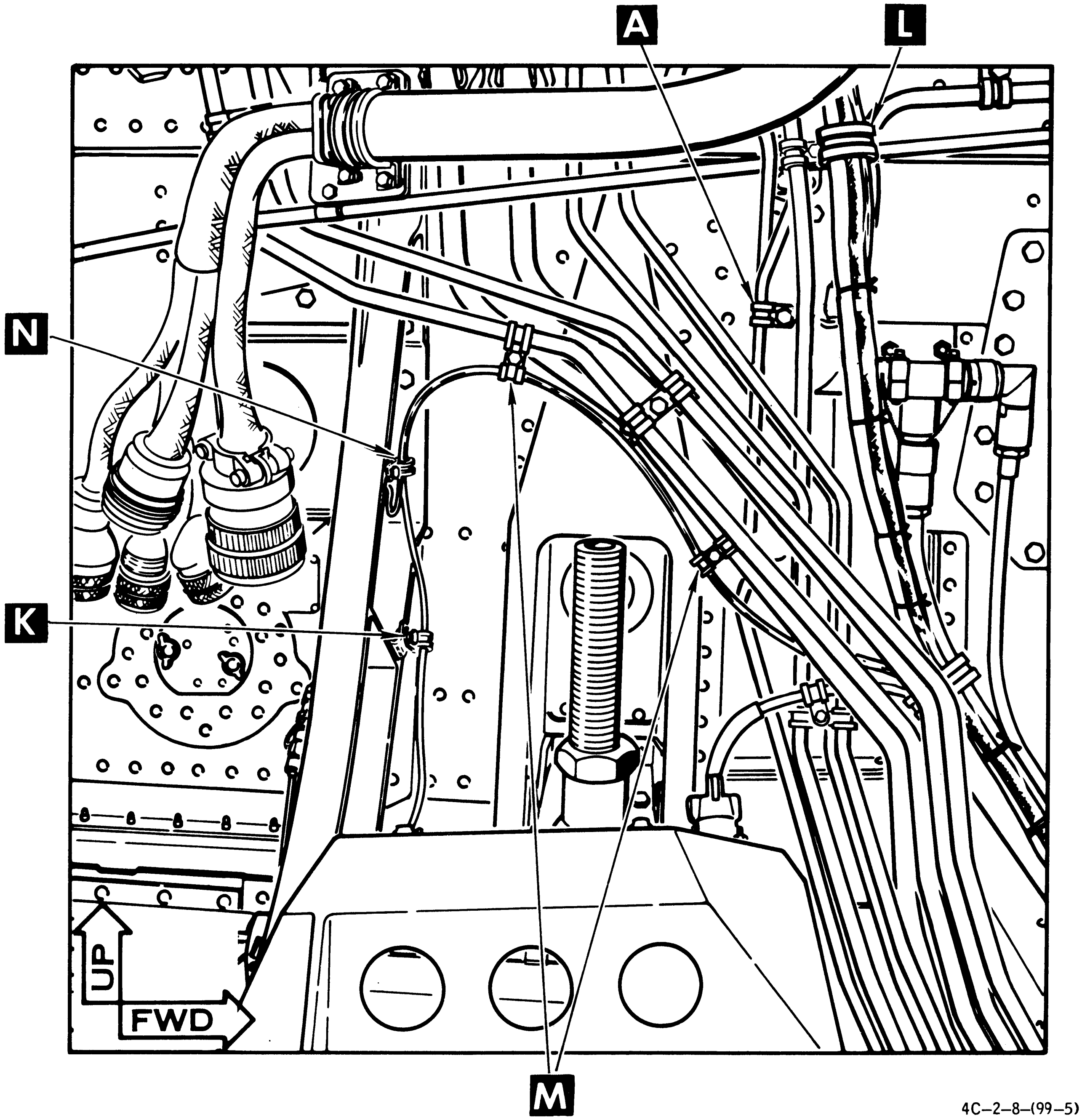
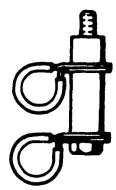
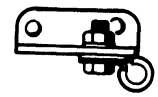


Figure 14-22. Right Engine Bay Zone F (Sheet 5 of 8)



DETAIL A



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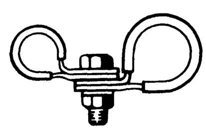

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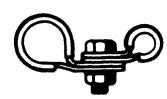

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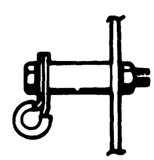
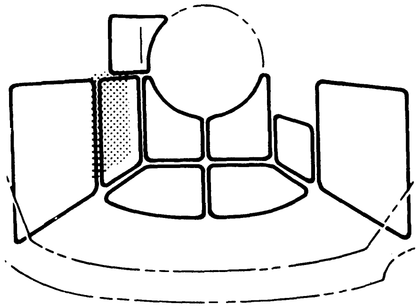


DETAIL N

4C-2-8-(99-6)

Figure 14-22. Right Engine Bay Zone F (Sheet 6 of 8)



CRITICAL INFORMATION			
INDEX	MINIMUM CLEARANCE	ANGLE	DESCRIPTION
1		1	ALJAC CABLE IN CLAMPS

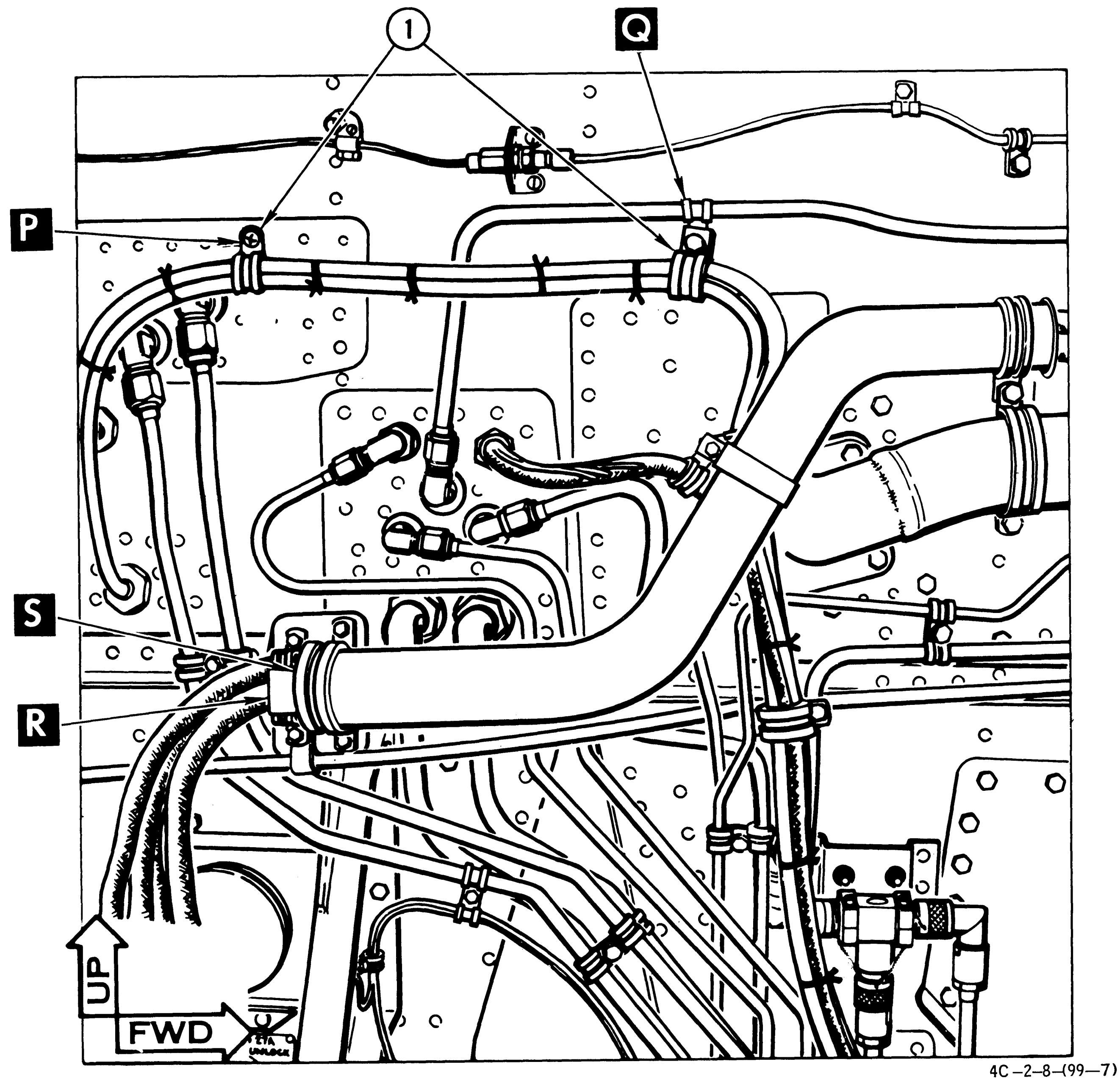
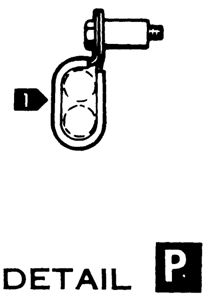
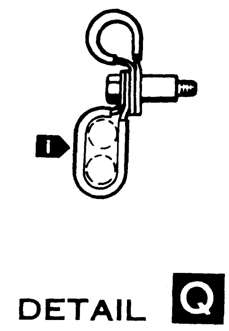


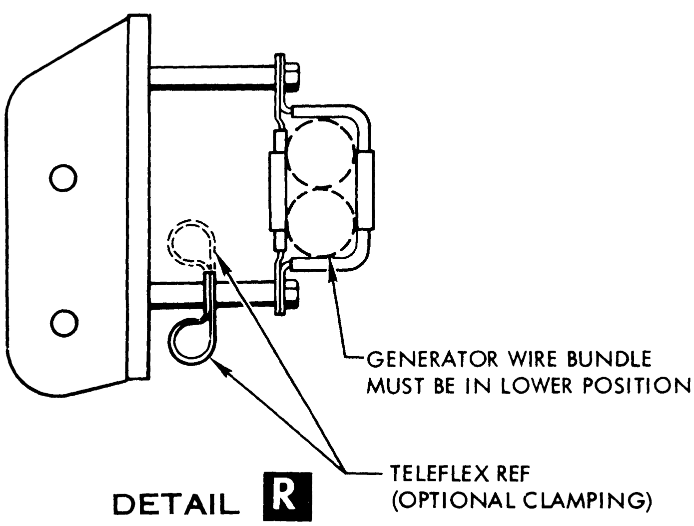
Figure 14-22. Right Engine Bay Zone F (Sheet 7 of 8)

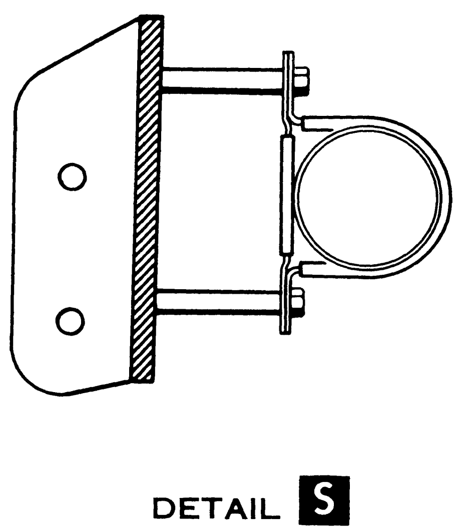
NOTE

1 ASSURE ALJAC CABLES ARE VERTICAL AS SHOWN.









4C-2-8-(99-8)

Figure 14-22. Right Engine Bay Zone F (Sheet 8 of 8)

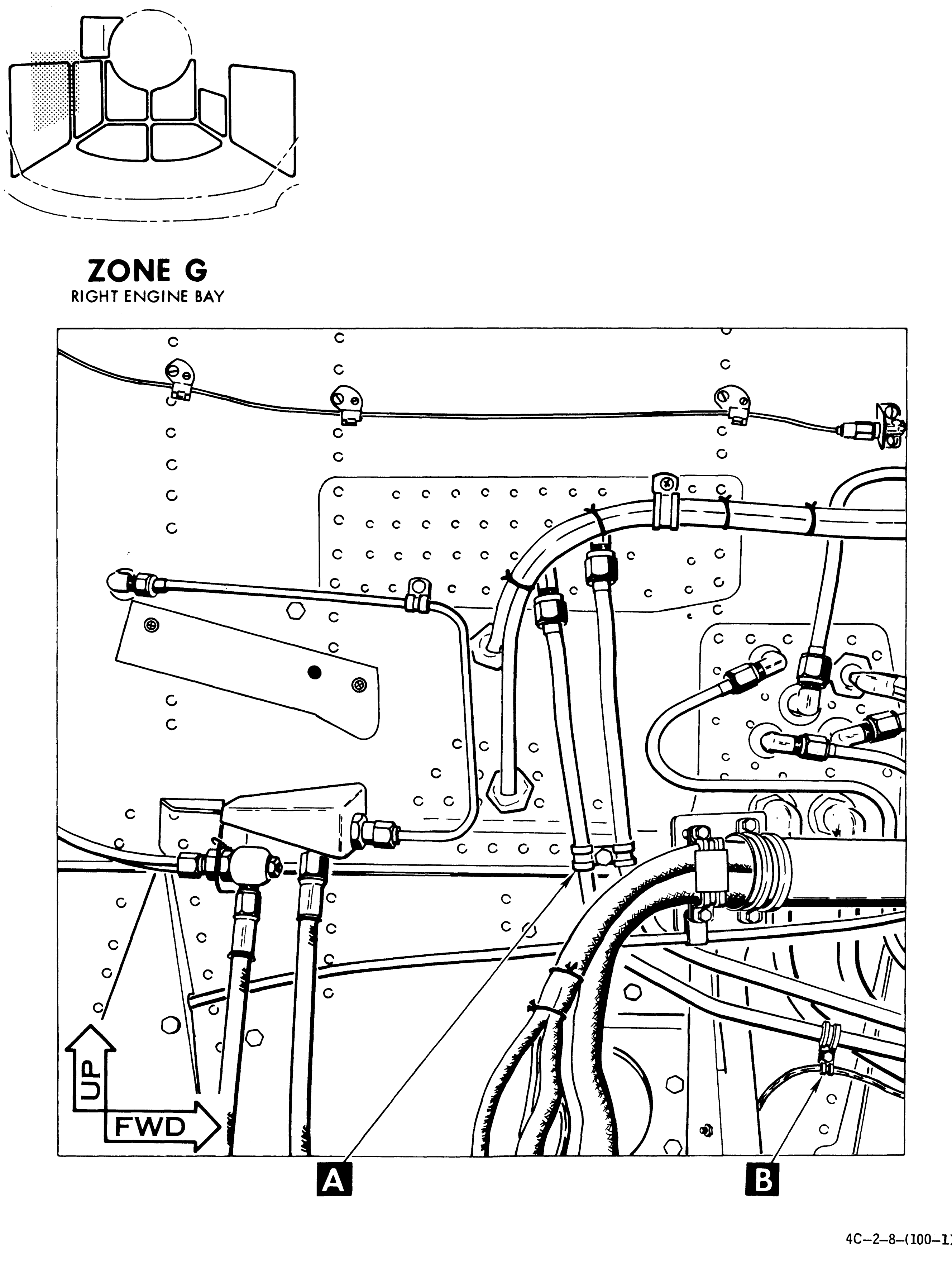
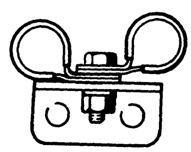
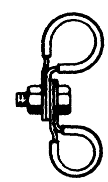


Figure 14-23. Right Engine Bay Zone G (Sheet 1 of 8)



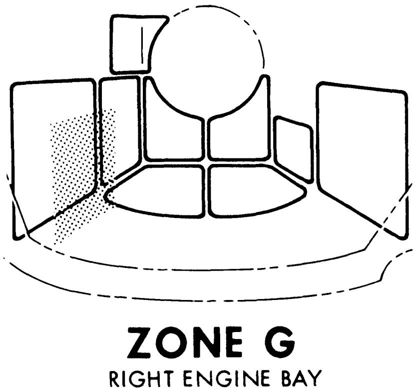
DETAIL A



DETAIL B

4C-2-8-(100-2)

Figure 14-23. Right Engine Bay Zone G (Sheet 2 of 8)



CRITICAL INFORMATION			
INDEX	MINIMUM CLEARANCE	ANGLE	DESCRIPTION
1	1 2		WIRE BUNDLE CLAMP

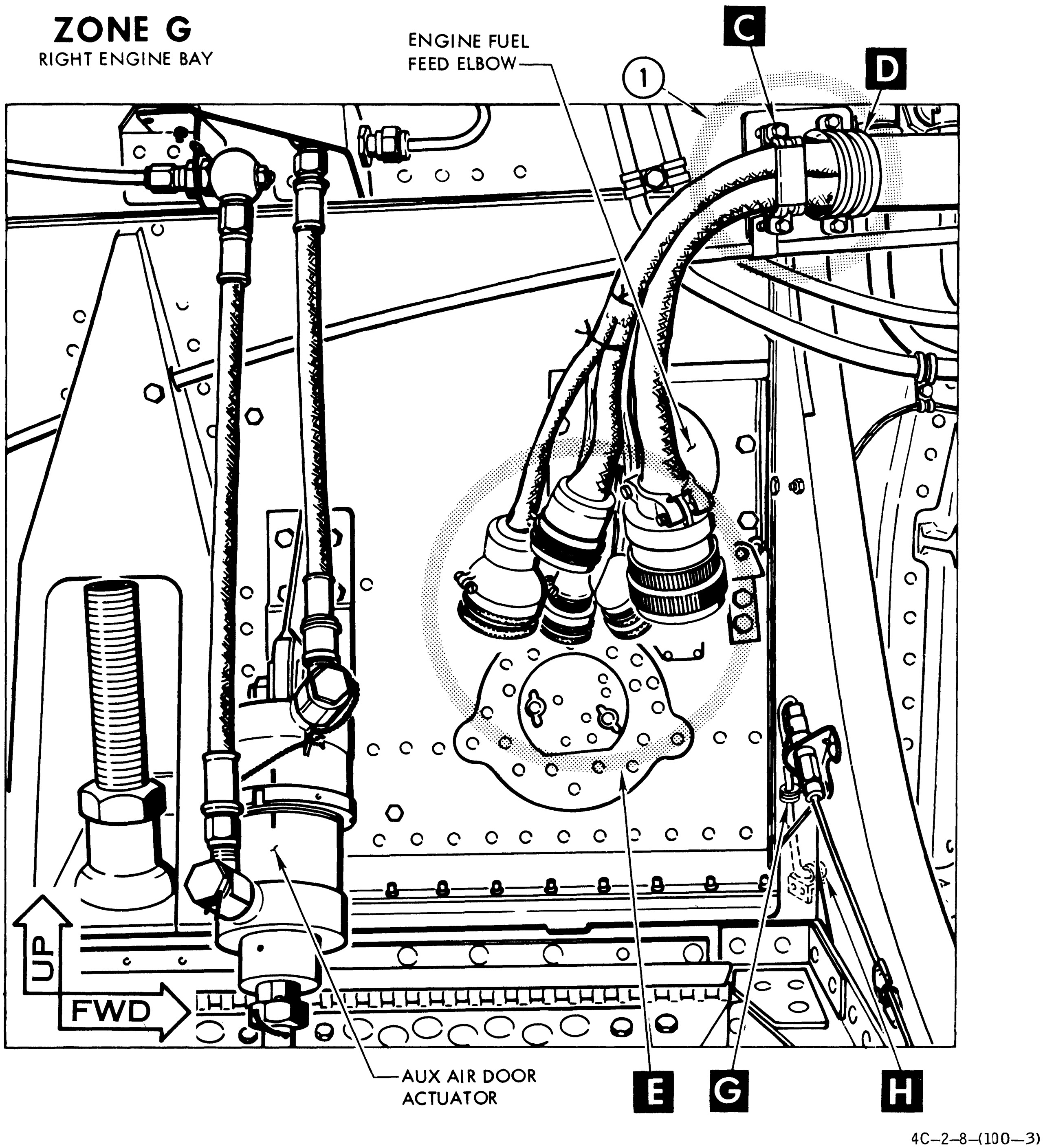
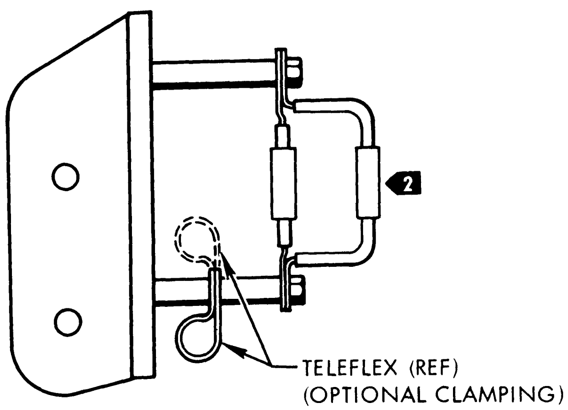


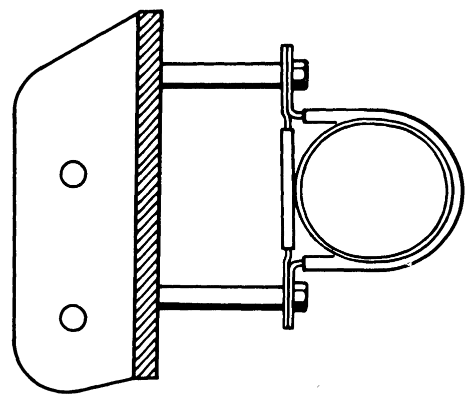
Figure 14-23. Right Engine Bay Zone G (Sheet 3 of 8)

NOTES

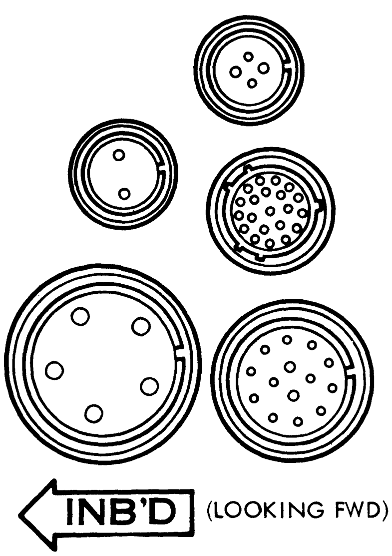
1. DISTANCE FROM AFT EDGE OF LAST CLAMP TO FACE OF PLUG 3P636 IS 13.00 $^{+0.25}_{-0.00}$ INCHES. DISTANCE FROM AFT EDGE OF LAST CLAMP TO FACE OF PLUG 52P636 IS 14.50 $^{+0.25}_{-0.00}$ INCHES.
2. ASSURE TWO 0.50 DIA., 1 INCH LONG SHRINK SLEEVES ARE INSTALLED ON CLAMP.



DETAIL C

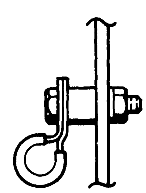


DETAIL D

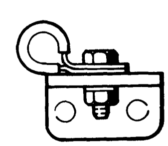


KEYWAYS MUST BE LOCATED AS SHOWN

DETAIL E



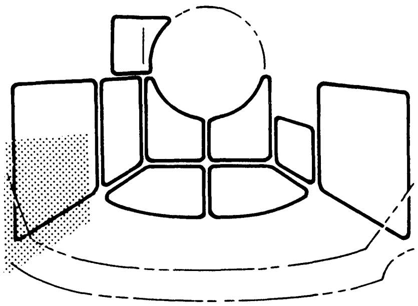
DETAIL G



DETAIL H

4C-2-8-(100-4)

Figure 14-23. Right Engine Bay Zone G (Sheet 4 of 8)



CRITICAL INFORMATION			
INDEX	MINIMUM CLEARANCE	ANGLE	DESCRIPTION
1		3	AUXILIARY AIR DOOR ACTUATOR

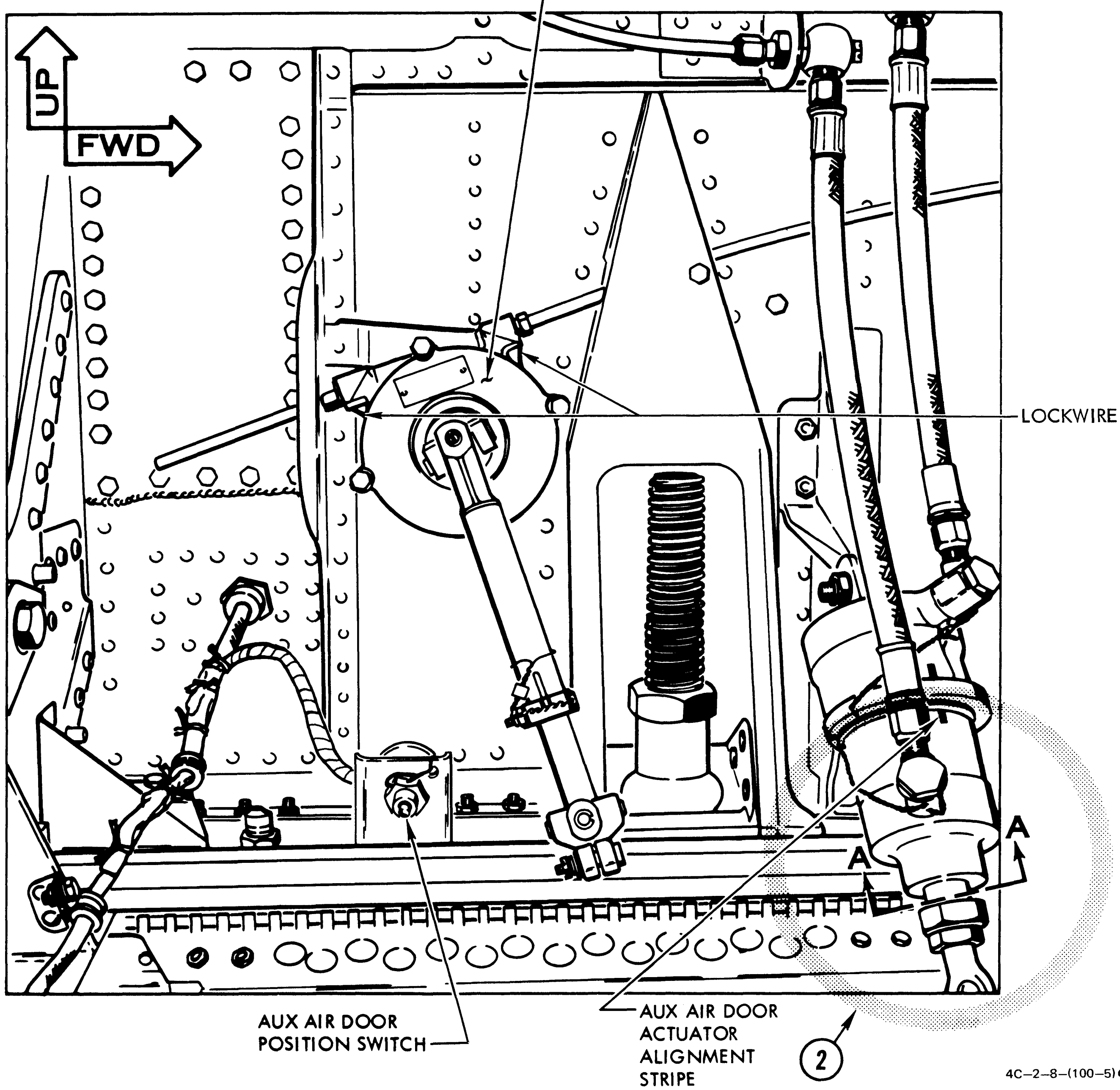
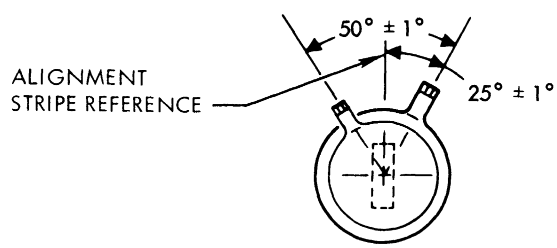


Figure 14-23. Right Engine Bay Zone G (Sheet 5 of 8)

NOTE

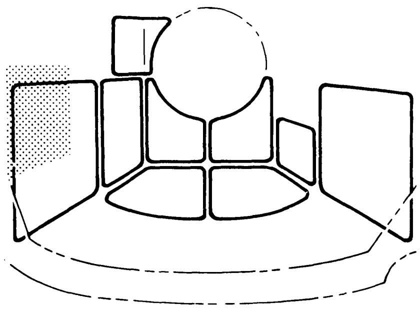
3 REFER TO T.O. 1F-4C-2-9 FOR REQUIRED MAINTENANCE INFORMATION. ACTUATOR TO BE IN INSTALLED POSITION DURING ALIGNMENT CHECK.



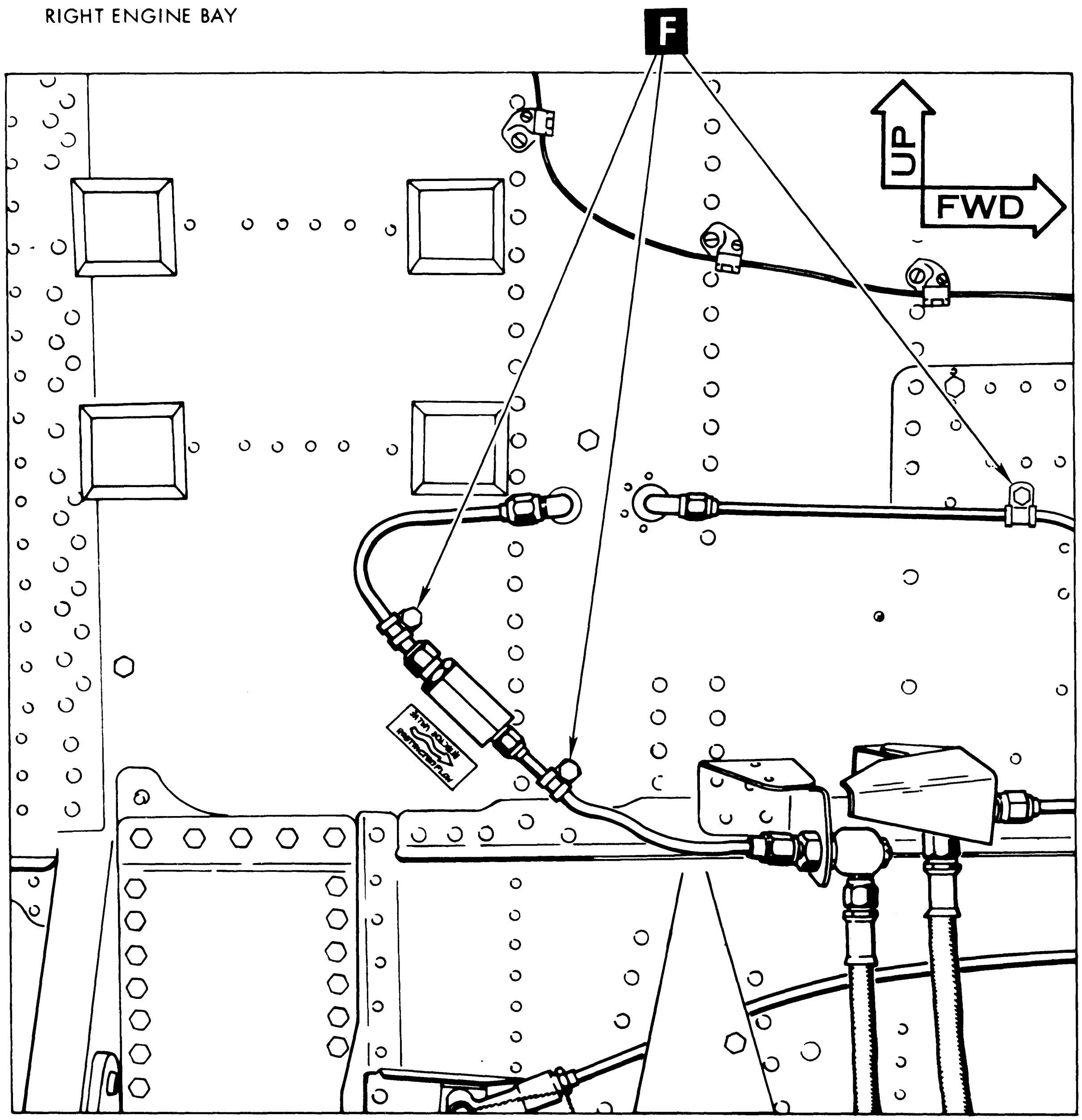
3 VIEW A-A

4C-2-8-(100-6)

Figure 14-23. Right Engine Bay Zone G (Sheet 6 of 8)

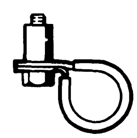


ZONE G
RIGHT ENGINE BAY



4C-2-8-(100-7)

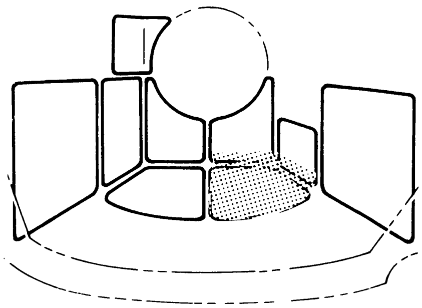
Figure 14-23. Right Engine Bay Zone G (Sheet 7 of 8)



DETAIL F

4C-2-8-(100-8)

Figure 14-23. Right Engine Bay Zone G (Sheet 8 of 8)



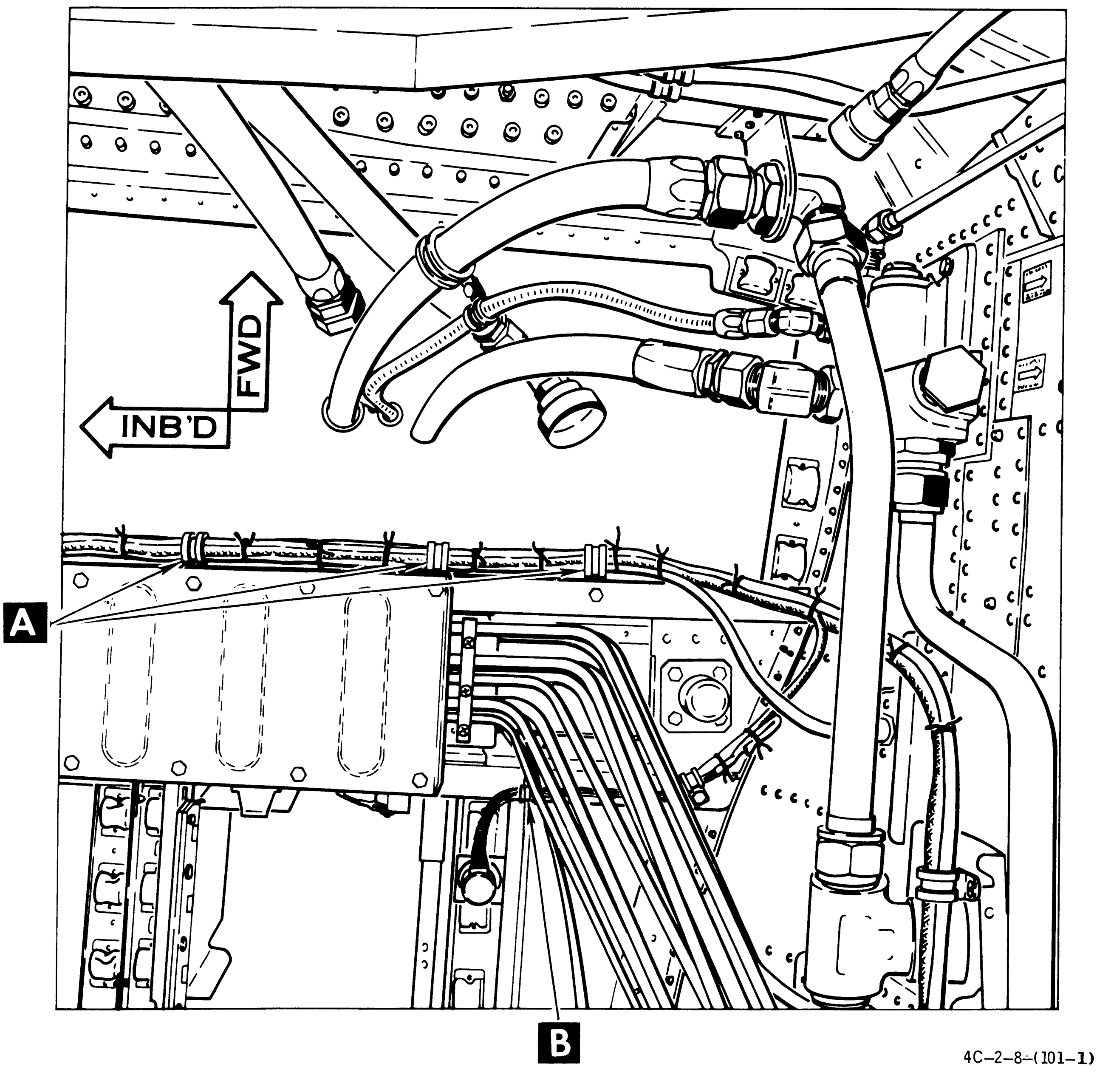
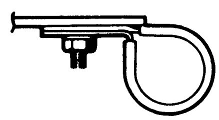
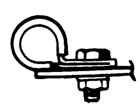


Figure 14-24. Right Engine Bay Zone H (Sheet 1 of 2)



DETAIL A



DETAIL B

4C-2-8-(101-2)

Figure 14-24. Right Engine Bay Zone H (Sheet 2 of 2)

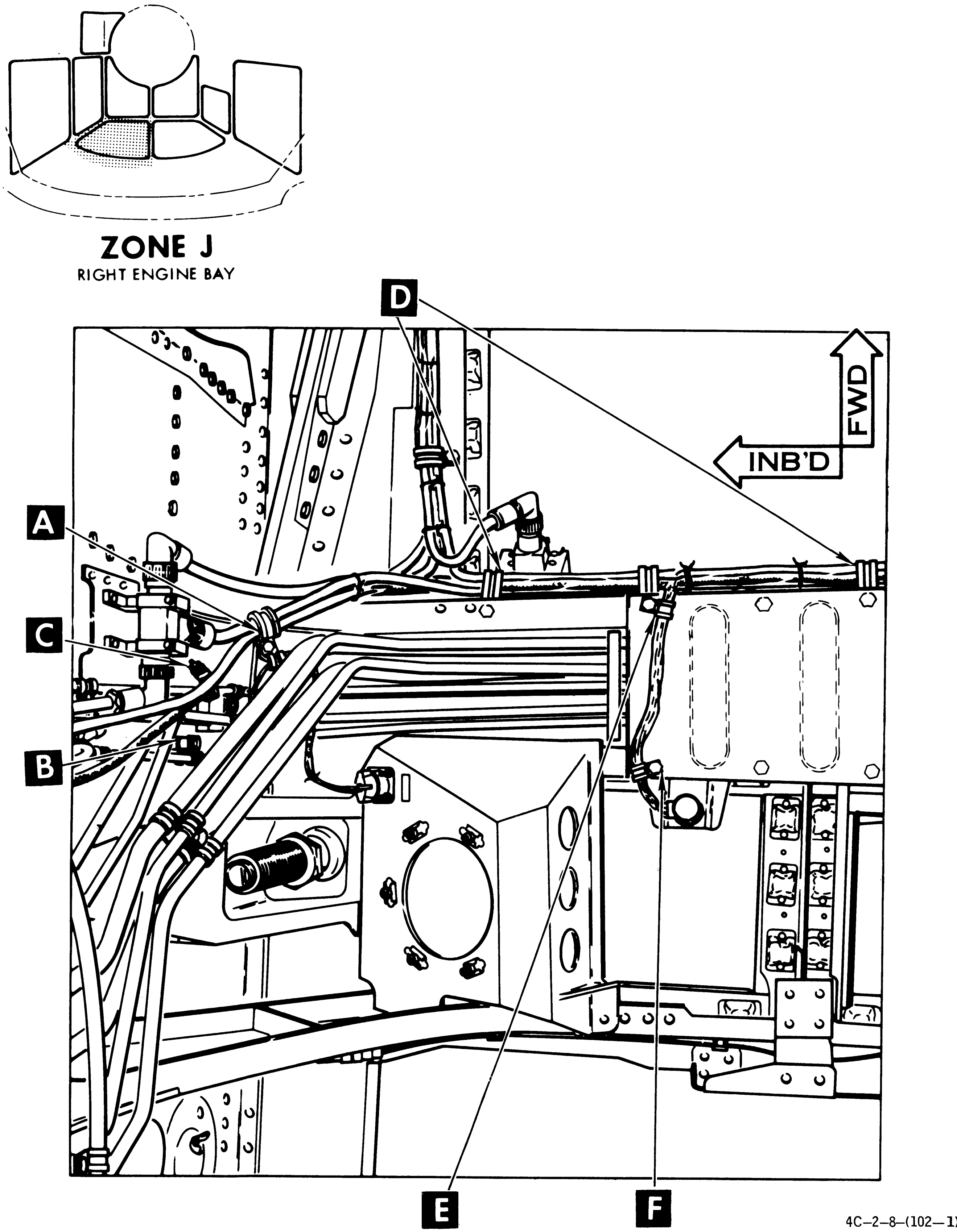
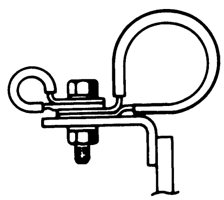
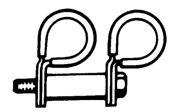


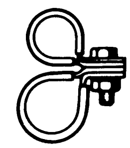
Figure 14-25. Right Engine Bay Zone J (Sheet 1 of 2)



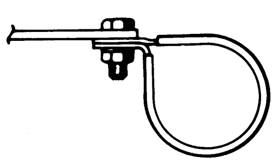
DETAIL A



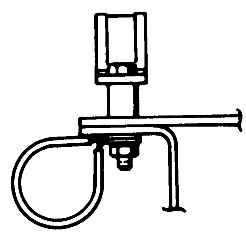
DETAIL B



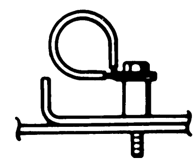
DETAIL C



DETAIL D



DETAIL E



DETAIL F

4C-2-8-(102-2)

Figure 14-25. Right Engine Bay Zone J (Sheet 2 of 2)

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ALPHABETICAL/NUMERICAL INDEX (CONT)

ALPHABETICAL/NUMERICAL INDEX (CONT)

B

ALPHABETICAL/NUMERICAL INDEX (CONT)

ALPHABETICAL/NUMERICAL INDEX (CONT)

ALPHABETICAL/NUMERICAL INDEX (CONT)

ALPHABETICAL/NUMERICAL INDEX (CONT)

D

ALPHABETICAL/NUMERICAL INDEX (CONT)

E

ALPHABETICAL/NUMERICAL INDEX (CONT)

ALPHABETICAL/NUMERICAL INDEX (CONT)

ALPHABETICAL/NUMERICAL INDEX (CONT)

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ALPHABETICAL/NUMERICAL INDEX (CONT)

Subject — **Paragraph, Figure, Table Number**

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ALPHABETICAL/NUMERICAL INDEX (CONT)

ALPHABETICAL/NUMERICAL INDEX (CONT)

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ALPHABETICAL/NUMERICAL INDEX (CONT)

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ALPHABETICAL/NUMERICAL INDEX (CONT)

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V

ALPHABETICAL/NUMERICAL INDEX (CONT)

ALPHABETICAL/NUMERICAL INDEX (CONT)

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Z